United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with University of Nebraska Conservation and Survey Division

Soil Survey of Sheridan County, Nebraska

How to Use This Soil Survey

General Soil Map

The general soil map, which is a color map, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

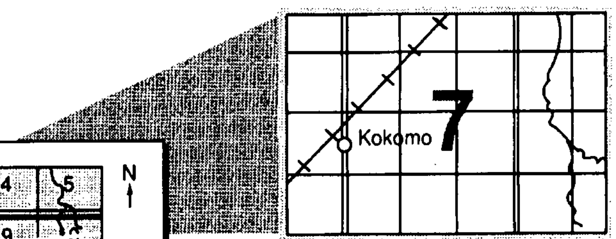
Detailed Soil Maps

The detailed soil maps can be useful in planning the use and management of small areas.

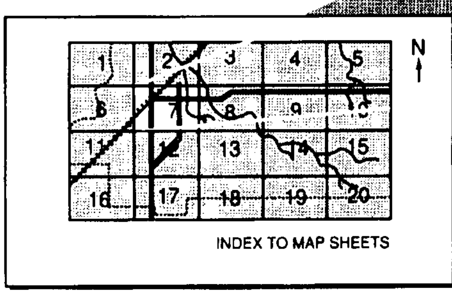
To find information about your area of interest, locate that area on the **Index to Map Sheets**. Note the number of the map sheet and turn to that sheet.

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units**, which lists the map units by symbol and name and shows the page where each map unit is described.

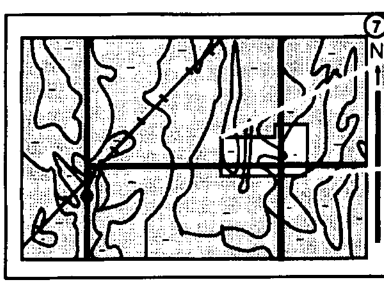
The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See the **Contents** for other sections of this publication that may address your specific needs.



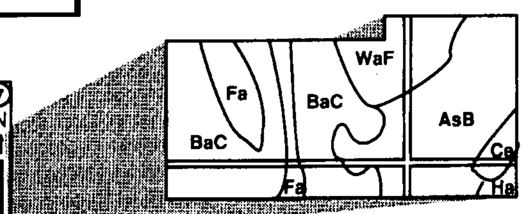
MAP SHEET



INDEX TO MAP SHEETS



MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1990. Soil names and descriptions were approved in 1992. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1992. This survey was made cooperatively by the Natural Resources Conservation Service and the University of Nebraska Conservation and Survey Division. The survey is part of the technical assistance furnished to the Upper Niobrara-White Natural Resource District. The Upper Niobrara-White Natural Resource District provided financial assistance to employ a soil scientist to accelerate completion of the soil survey.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Beaver Wall in northern Sheridan County. The Thirtynine soils in the areas below the wall are used as rangeland.

Additional information about the Nation's natural resources is available on the Natural Resources Conservation Service home page on the World Wide Web. The address is http://www.nrcs.usda.gov (click on "Technical Resources").

Contents

Issued 2002

Index to Map Units

Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Sheridan County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Stephen K. Chick
State Conservationist
Natural Resources Conservation Service

Soil Survey of
Sheridan County, Nebraska

By Gary L. McCoy, Robert L. Rayer, Charles F. Mahnke, Daniel R. Shurtliff, Arthur L. Voigtlander, and Casey W. Latta, Natural Resources Conservation Service; and Phillip D.Young, David R. Hoover, Monte K. Babcock, Jeffrey A. Green, Jeffrey F. Worm, Stephan J. Lobaugh, Neal B. Stolpe, and Charles E. Morris, University of Nebraska, Conservation and Survey Division

United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with the
University of Nebraska Conservation and Survey Division

SHERIDAN COUNTY is in the northwestern part of Nebraska (fig. 1). The total land area is about 1,582,189 acres, or about 2,472 square miles. The county is about 36 miles wide from east to west and about 69 miles long from north to south. It is bordered on the north by Shannon County, South Dakota; on the east by Cherry County, Nebraska; on the south by Garden County, Nebraska; and on the west by Box Butte and Dawes Counties, Nebraska.

According to the 1990 census, the population of Sheridan County is 6,733. Rushville, the county seat, has a population of 1,217, and Gordon, the largest town, has a population of 2,245.

Sheridan County generally has good transportation facilities. The towns in the northern part of the county are served by the Nebkota Railroad, which follows U.S. Highway 20 between Merriman in Cherry County and Chadron in Dawes County. The Burlington Northern Santa Fe Railroad follows State Highway 2 in the southern part of the county. State Highways 27, 250, and 87 run north and south through the county. Many improved county roads are in the northern part of the county. Few roads are in the sandhills. Gordon, Rushville, and Hay Springs have airfields for small, private aircraft. Commercial air transportation is available at Chadron in Dawes County.

The general economy of the county is based primarily on cattle ranching and the production of hay, winter wheat, and irrigated corn. Most of the employment in the county is in farming and ranching or businesses related to agriculture.

About 70 percent of the county is rangeland and about 23 percent is cropland. Most of the cropland is dry-farmed. About 20 percent of the cropland is irrigated. Some of the areas that are dry-farmed do not have a suitable source of ground water for irrigation.

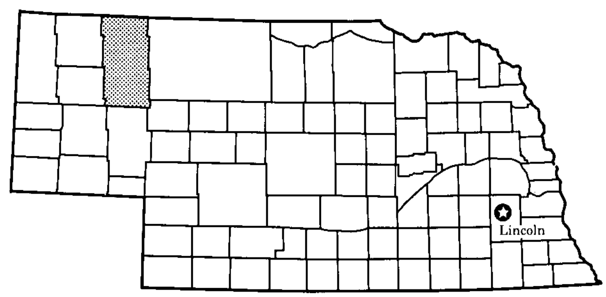


Figure 1.—Location of Sheridan County in Nebraska.

This soil survey updates the survey of Sheridan County published by the U.S. Department of Agriculture in 1921 *(7)*. It provides a more detailed soil survey on aerial photography and contains more interpretive information.

General Nature of the County

This section provides information about history and development; physiography, relief, and drainage; geology; ground water; and climate of Sheridan County.

History and Development

In the summer of 1874 the Army established Camp Sheridan, named after General Phil Sheridan, near the Spotted Tail Indian Agency *(7)*. At that time few settlers were in the area that would later become Sheridan County. In 1878 the first permanent settlement in Sheridan County was established along White Clay Creek. The first settlers were open range cattlemen who wanted to take advantage of the lush grasses in the sandhills and gold seekers on their way to the gold fields in the Black Hills of South Dakota. The completion of the railroad in 1885 brought more settlers seeking homesteads under the public land laws. Conflicts were common between the settlers and the open range cattlemen until the Herd Law of 1887 ended open range grazing by the cattlemen.

Settlements and towns were quickly established, and Sheridan County was established in 1885. The towns of Gordon, Hay Springs, and Rushville were established that year along the railroads, and farming prospered in the county. Rushville was narrowly voted in as the county seat over Hay Springs. The towns of Antioch, Hoffland, and Lakeside developed around the potash industry in the southern part of the county. For a short time during World War I this potash operation was the largest in the country.

The census of 1890 showed a population of 8,687 in Sheridan County. The 1930 census showed the county's population had grown to 10,793. Since that time the county has seen a steady decline to the current total of 6,733, according to the 1990 census. In 1910 the entire population was rural. Today about 53 percent is urban, and about 47 percent is rural. Cattle ranching remains the largest enterprise in the county.

Physiography, Relief, and Drainage

Sheridan County lies in the High Plains region of the Great Plains. The county can be subdivided into four major landform groups. The part of the county south of the Niobrara River, or about 60 percent of the total area of the county, is part of the sandhills. About a third of the county north of the Niobrara River to the Pine Ridge escarpment is a tableland that dips to the southeast. This tableland makes up the highest and most nearly level land in the county. It is a remnant of the High Plains and is a transitional area between the sandhills and the Pine Ridge escarpment on its northwestern edge. In the extreme northwest corner of the county is the Chadron Dome, which exposes the oldest geologic materials.

Except for the northwestern part, the entire county is drained by the Niobrara River and its tributaries. Hay Springs, Rush, and Antelope Creeks are tributaries of the Niobrara River from the tableland to the north. They have intermittent flow, depending on surface runoff and the time of year. Their stream gradients are gradual to the southeast, their flow is slow, and their flood plains are relatively wide.

The tributaries of the Niobrara River from the south, except for Box Butte Creek, drain the sandhills. Box Butte Creek drains the area of loamy soils west of the sandhills. Underground seepage keeps the flow fairly constant throughout the year. In low valleys of the sandhills water accumulates in lakes and ponds. The soils in basins that have no outflow from these lakes and ponds are slightly alkaline to strongly alkaline. Smith Lake has an outlet near Pine Creek, which allows drainage and an inflow of fresh water.

Streams in the northwestern part of the county drain into the White River. The largest tributaries of the White River in Sheridan County are Beaver, White Clay, and Wounded Knee Creeks. These streams have a steep gradient and are actively deepening their channels.

The elevation in the county ranges from about 4,000 feet north of Hay Springs near the northwest breaks called the Pine Ridge to about 3,500 feet where the Niobrara River exits the county to the east.

Geology

Jim Kearney, geologist, Natural Resources Conservation Service, prepared this section.

The oldest exposed rocks in Sheridan County are the Carlile Shale, the Niobrara Formation, and the Pierre Shale of the Cretaceous period. These units are in a small area of about 25 square miles in the extreme northwest corner of the county. The Niobrara Formation, which consists of chalk, calcareous shale, and limestone, is the most extensive of the units.

In other areas of the county, from oldest to youngest, Tertiary rocks of the White River Group; the Chadron and Brule Formations; the Gering, Monroe Creek, and Harrison Formations of the Arikaree Group; and the Ogallala Group form the bedrock. The Brule Formation and the formations of the Arikaree Group crop out or are near the surface throughout much of the northern fourth of the county. Topographically, this area is the steeply eroded, northwest-facing slope of the Pine Ridge. The Brule Formation is pinkish to brownish siltstone and sandy siltstone containing occasional sandstone beds. It is believed to have formed mainly from wind-deposited silt made up mainly of shards and fragments of volcanic glass. The Gering Formation is mainly buried

valley and small channel deposits of grayish, very fine- to medium-grained sandstones. The overlying beds of the Monroe Creek and Harrison Formations are pale brownish, very fine and fine, silty sandstone and sandy siltstone containing calcareous nodules and concretions. Much of the material in these beds may have been deposited by the wind.

The Ogallala Group of Miocene (later Tertiary) age forms the bedrock in the extreme northeastern corner and the southern three-fourths of the county. It extends south of a line roughly about 12 miles north of and parallel to the Niobrara River. Originating from an ancient flood plain and from stream deposits of quartz, feldspar, and rock fragments from mountains to the west, the rocks in the Ogallala Group have lithologies varying among silty and silty clay sandstones, sandy and clayey siltstones, caliche limestones, and sand and gravel. Cementation is by carbonates, compaction of the silt and clay matrix, and clay weathered from feldspars and other mineral fragments. The colors of the rocks include gray, greenish-gray, brown, and white. The thickness of the Ogallala Group is more than 350 feet in the area where it fills an east-west trending paleovalley across central Sheridan County.

Deformation associated with the uplifts of the mountains to the west and the Black Hills to the north has profoundly influenced the geology in Sheridan County. The Chadron Arch, which crosses the subsurface from southeast to northwest near the center of the county, forms the eastern edge of the Denver-Julesburg structural basin to the southwest. Folding and faulting has influenced the positioning of the bedrock units, the erosion exposing them, and the drainage features in the county.

Unconsolidated Quaternary deposits are generally less than 50 feet thick in the northern part of the county north and west of the Nebraska Sandhills that mainly border the Niobrara River. In parts of the Niobrara River valley these deposits are more than 100 feet thick. These sediments occupy a limited area on the uplands and are formed by wind-deposited silt and sand along with slope wash. In the stream valleys sandy and silty alluvial deposits form relatively flat flood plains and terraces.

In the extreme northeastern corner of the county and southward from near the Niobrara River, the Quaternary deposits include bedded sequences of locally silty sand and gravel, silty and clayey sands, silt, and clayey silt that are predominantly fluvial in origin. These deposits are overlain by young dune sand that is predominantly fine sand in a variety of sand dune, interdune, and sand sheet configurations that are more than 200 feet thick.

Ground Water

Jim Kearney, geologist, Natural Resources Conservation Service, prepared this section.

Ground water is the primary source of water for all uses in Sheridan County. In the northern part of the county, rocks are the primary water-bearing formations. The White River Group is a relatively poor source of water. Locally, its Chadron Formation contains small amounts of water in sandstone and gravel beds, but water quality is often poor. The Brule Formation also is an undependable source of water, although some joints, fractures, or faults in the fine-grained siltstone, as well as some sandstone beds, yield enough water for livestock and domestic uses.

The Arikaree and Ogallala Groups form the major aquifers in northern Sheridan County. At the base of the Arikaree Group, the Gering Formation contains permeable sand and sandstone that provide water for nearly any use. The thicker Monroe Creek and Harrison Formations above the Gering Formation are formed by the less permeable silty, fine-grained sandstone and sandy siltstone that generally supply water only for livestock or domestic uses. The Arikaree Group contains a large amount of water because it has a saturated thickness of as much as 450 feet. This Group is a complex system of paleovalley deposits with a considerable thickness of fine-grained rocks; therefore, it yields a large amount of water only if a thick interval of the saturated upper formation is penetrated or if the interval includes a thickness of the basal sandstone.

The Ogallala Group contains the most permeable rocks in northern Sheridan County and, in places, is a major source of water. The grain size, sorting, fabric, cementation of the rocks, and complex interbedding can influence the efficiency and usefulness of the Ogallala Group as an aquifer.

The complex structural geology of northern Sheridan County affects the occurrence of ground water in the bedrock. Because of tilted beds and faults, the continuity of deposits is interrupted, thus influencing the occurrence, direction, and rate of movement of ground water in permeable rocks. However, joints and fractures enhance storage and movement of water in otherwise relatively impermeable masses of rock.

The unconsolidated Quaternary alluvium forms the stream terraces and flood plains in the Niobrara River valley and the smaller stream valleys in northern Sheridan County. It provides aquifers that yield small quantities of water for livestock and domestic uses, especially in areas of coarse-grained alluvium.

The configuration of the water table in northern Sheridan County is affected by topography. The Pine Ridge separates two distinctly different gradients and shapes in the water table. In the northwestern part of the county north of the Pine Ridge, the gradient is apparently steep and generally north-northwest, reflecting the relatively steep topography and low permeable rocks. The general configuration has local variations because of the topographically high outlines from the Pine Ridge. South of the Pine Ridge, the gradient is less steep and is in an easterly direction, reflecting more subdued topography and the presence of more permeable rocks, such as the Ogallala Group. In the northeastern part of the county, where the Pine Ridge is subdued, the ground water divide is also less prominent and trends east-southeast. The actual shape of the ground water table throughout the northern part of the county is quite complicated because of the many extremes in topography, geologic structure, stratigraphy, tilt of the beds, and hydraulic conductivity. The source of ground water in the area is local precipitation. Discharge to the north of the Pine Ridge is mainly through the stream systems. South of the Pine Ridge, discharge is to stream systems, ponds, and the Niobrara River, which is a principal area of ground water discharge.

The occurrence of ground water south of the Niobrara River differs from that in the northern part of the county. The main aquifers are the Ogallala Group and the unconsolidated Pliocene through Quaternary alluvial sediments. The Ogallala Group is the oldest and thickest aquifer and ranges from about 300 to more than 700 feet thick. The dune sand that mantles southern Sheridan County is extremely important in the total hydrology of the area but does not yield large quantities of water.

Southern Sheridan County is underlain by a shallow ground water mound that extends into parts of Cherry, Grant, Garden, and Morrill Counties. Ground water flows outward from the mound in all directions. The source of the ground water is precipitation that is rapidly absorbed by the sand or flows as runoff to the numerous lakes and valleys in the sandhills. Little, if any, surface water normally flows out of southern Sheridan County. The interaction among precipitation, the hydrology of the lakes and wetlands, and ground water is complicated and not completely understood. The hydraulic connection between the lakes and ground water apparently varies from lake to lake.

Conditions of the aquifers and ground water throughout Sheridan County are complex, but the quantity and quality of the water is good for most uses.

Climate

In Sheridan County, winters are cold because of incursions of cold, continental air that bring fairly frequent spells of low temperatures. Summers are hot but occasionally are interrupted by cooler air from the north. Snowfall is fairly frequent in winter, but the snow cover is usually not continuous. Rainfall is heaviest in late spring and early summer. The annual precipitation is normally adequate for wheat, sorghum, and range grasses.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Hay Springs in the period 1951 to 1987. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 26 degrees F and the average daily minimum temperature is 13 degrees. The lowest temperature on record, which occurred at Hay Springs on January 19, 1963, is -31 degrees. In summer, the average temperature is 70 degrees and the average daily maximum temperature is 85 degrees. The highest recorded temperature, which occurred on July 6, 1963, is 110 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 20 inches. Of this, 15 inches, or 75 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 13 inches. The heaviest 1-day rainfall during the period of record was 4.15 inches at Hay Springs on June 20, 1965. Thunderstorms occur on about 44 days each year.

The average seasonal snowfall is 57 inches. The greatest snow depth at any one time during the period of record was 26 inches. On the average, 20 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 50 percent. Humidity is higher at night, and the average at dawn is about 75 percent. The sun shines 70 percent of the time possible in summer and 60 percent in winter. The prevailing wind is from the

northwest. Average windspeed is highest, 13 miles per hour, in spring.

Severe duststorms occur occasionally in the spring, when strong, dry winds blow across unprotected soils. Tornadoes and severe thunderstorms, some of which are accompanied by hail, occur occasionally. These storms are local in extent and of short duration. The damage is variable and spotty.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are named and mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Some soil boundaries and soil names in this survey do not fully match those in the surveys of adjoining counties that were published at an earlier date. Differences are the result of changes and refinements in series concepts, variations in slope groupings, and application of the latest classification system.

Soil Descriptions

Areas of Soils Formed in Material Weathered from Interbedded Chalk and Shale or from Siltstone and Areas of Rock Outcrop

Two associations are in this group. These soils formed in material weathered from interbedded chalk and shale or siltstone. Most of the acreage of the soils in this group supports native grasses used for range. The rest is cultivated. Soil blowing and water erosion are the principal hazards. Regulating the timing and intensity of grazing and improving the range condition are the principal concerns affecting rangeland. Improving fertility and controlling soil blowing are the main concerns affecting cultivated areas.

1. Enning-Rock outcrop-Minnequa association

Areas of Rock outcrop and shallow and moderately deep, gently sloping to very steep, well drained, silty soils; on uplands

This association is in the northwestern corner of the county, which is known locally as the Chadron Dome. It consists of gently sloping to very steep side slopes and ridges and broad, gently sloping foot slopes. Rough, broken side slopes and escarpments are along some of the deeply entrenched drainageways. Runoff flows toward the White River.

This association makes up about 19,840 acres, or about 1 percent of the county. It is about 38 percent Enning soils, 23 percent areas of Rock outcrop, 12 percent Minnequa soils, and 27 percent minor soils.

The strongly sloping to very steep Enning soils are on ridgetops and breaks adjacent to intermittent drainageways. They are shallow and well drained. They formed in material weathered from interbedded chalk and shale. Typically, the surface layer is grayish brown, friable, calcareous silty clay loam about 3 inches thick. The transitional layer is light brownish gray, friable, calcareous silty clay loam about 4 inches thick. The underlying material is light gray, friable, calcareous silty clay loam to a depth of 18 inches. Below a depth of 18 inches is interbedded chalk and shale.

The areas of Rock outcrop are on the dissected side slopes and escarpments of upland breaks and deeply entrenched drainageways. Rock outcrop is weathered, interbedded limestone and shale.

The gently sloping to steep Minnequa soils are on the smoother side slopes of the uplands. These soils are moderately deep and well drained. They formed in material weathered from interbedded chalk and shale. Typically, the surface layer is grayish brown, friable,

calcareous silty clay loam about 4 inches thick. The transitional layer is light brownish gray, friable, calcareous silty clay loam about 6 inches thick. The underlying material extends to a depth of 33 inches. The upper part is light brownish gray, friable, calcareous silty clay loam. The lower part is light gray, very friable, calcareous silt loam. Below a depth of 33 inches is interbedded chalk and shale.

Of minor extent in this association are Bufton and Manvel soils. The very deep Bufton soils are on high upland divides and on stream terraces and foot slopes. The very deep Manvel soils are on foot slopes and stream terraces and formed in colluvial and alluvial outwash material from the surrounding uplands.

Nearly all of this association supports native grasses and is used for grazing. Nearly all of the acreage is used for feeder calf operations. A small area of the gently sloping soils is cultivated, and dryland wheat and alfalfa are the main crops.

The major soils in this association contain selenium, and livestock that graze continuously in the area are subject to selenium poisoning. Insufficient seasonal rainfall limits the growth of grasses. An inadequate supply of water for livestock limits grazing. Precipitation that accumulates in stock-water ponds is the only source of water for livestock except in areas served by pipelines. Wells yield low quantities of water that has a high mineral content. Some of this water is not suitable for domestic use.

Water erosion and soil blowing are hazards affecting cultivated areas. The soils are low in natural fertility.

Very few ranch headquarters are in this association. Trails supplement the one unimproved dirt road that crosses part of the area. Ranch products are marketed locally.

2. Thirtynine-Kadoka-Epping association

Very deep, moderately deep, and shallow, nearly level to very steep, well drained, silty and loamy soils; on uplands

This association is between the Pine Ridge and the Chadron Dome. It consists mainly of nearly level to very steep ridgetops, side slopes, and breaks along creeks and intermittent drainageways. The creeks originate mainly in the Pine Ridge area and flow north toward the White River.

This association makes up about 30,720 acres, or about 2 percent of the county. It is about 27 percent Thirtynine soils, 22 percent Kadoka soils, 19 percent Epping soils, and 32 percent minor soils.

The nearly level to strongly sloping Thirtynine soils are on broad ridgetops and side slopes. These soils are very deep and well drained. They formed in loamy material weathered from siltstone. Typically, the surface layer is grayish brown, friable loam about 8 inches thick. The subsoil is 17 inches thick. The upper part is brown and light brownish gray, firm silty clay loam. The lower part is light gray, friable, calcareous silt loam. The underlying material is very pale brown, calcareous very fine sandy loam to a depth of more than 60 inches.

The nearly level to strongly sloping Kadoka soils are on broad ridgetops and side slopes. These soils are moderately deep and well drained. They formed in silty material weathered from siltstone. Typically, the surface layer is grayish brown, friable silt loam about 7 inches thick. The subsoil is about 20 inches thick. The upper part is brown, friable silty clay loam; the middle part is pale brown, friable silt loam; and the lower part is very pale brown, friable, calcareous silt loam. The underlying material is very pale brown, calcareous silt loam to a depth of 32 inches. Below a depth of 32 inches is very pale brown, bedded siltstone.

The gently sloping to very steep Epping soils are on narrow ridgetops and breaks along intermittent drainageways. These soils are shallow and well drained. They formed in loamy sediments weathered from siltstone. Typically, the surface layer is light brownish gray, very friable very fine sandy loam about 3 inches thick. The transitional layer is pale brown, very friable, calcareous very fine sandy loam about 3 inches thick. The underlying material is very pale brown, calcareous very fine sandy loam to a depth of 15 inches. Very pale brown siltstone is below a depth of 15 inches.

Of minor extent in this association are Bufton, Orella, Mitchell, and Bridget soils. Bufton soils are very deep and are on broad ridgetops and side slopes. Orella soils are shallow and are on side slopes. Mitchell soils are very deep and are on moderately steep and steep side slopes. Bridget soils are very deep and are on foot slopes in the Pine Ridge area and on stream terraces. They formed in colluvial and alluvial outwash material from the surrounding uplands.

Farms in this association are diversified. Most of the farms are cash-grain and livestock enterprises. Most of the acreage of the soils in this association supports native grasses and is used for grazing or hay. The main livestock enterprise is the production of beef cattle. About 40 percent of this association is cultivated. Dryland wheat, millet, and alfalfa are the principal crops.

Areas of Soils Formed in Material Weathered from Calcareous Sandstone and Areas of Rock Outcrop; in the Pine Ridge Area

Only one association is in this group. The soils formed in material weathered from calcareous sandstone in the Pine Ridge. Nearly all of the acreage of the soils in this group support native grasses and woodland and are used mainly for grazing. Soil blowing and water erosion are the principal hazards. Regulating the timing and intensity of grazing and improving the range condition are the principal concerns affecting range. Improving woodland management by thinning stands to release growing stock trees is a concern. Improving fertility and controlling soil blowing are the main concerns affecting cultivated areas.

3. Tassel-Ponderosa-Rock outcrop association

Areas of Rock outcrop and shallow and very deep, strongly sloping to very steep, well drained, loamy soils; on uplands

This association is in the northern part of the county and is known locally as the Pine Ridge. It consists mainly of steep and very steep side slopes, ridges, and breaks that are covered with ponderosa pine. Many areas of rock outcrop, canyon walls, and escarpments are in this area. The rest of the area is strongly sloping to steep.

This association makes up about 137,600 acres, or about 9 percent of the county. It is about 40 percent Tassel soils, 30 percent Ponderosa soils, 11 percent areas of Rock outcrop, and 19 percent minor soils (fig. 2).

The strongly sloping to very steep Tassel soils are on ridgetops, on breaks adjacent to intermittent drainageways, and on side slopes of valleys and canyons. They are shallow and well drained. They formed in loamy material weathered from calcareous sandstone. Typically, the surface layer is pale brown, very friable, calcareous very fine sandy loam about 4 inches thick. The underlying material is very pale brown, calcareous very fine sandy loam to a depth of 14 inches. Below a depth of 14 inches is very pale brown, calcareous sandstone.

The strongly sloping to very steep Ponderosa soils are on the middle and lower side slopes. They are very deep and well drained. They formed in sandy and loamy sediments weathered from calcareous sandstone. Typically, the surface layer is grayish brown, very friable very fine sandy loam about 12 inches thick. The transitional layer is pale brown, very friable very fine sandy loam about 9 inches thick. The underlying material to a depth of more than 60 inches is light brownish gray very fine sandy loam in the upper part and very pale brown, calcareous loamy very fine sand in the lower part. Sandstone fragments are common throughout the underlying material.

Areas of Rock outcrop are on narrow upland divides and along upland breaks, escarpments, and canyon walls. It is the steepest part of the landscape. Rock outcrop consists of calcareous sandstone.

Of minor extent in this association are Jayem, Oglala, Munjor, and Vetal soils. Jayem and Oglala soils are on ridgetops and side slopes on uplands. Munjor soils are on bottom land along streams flowing out of the Pine Ridge area. Vetal soils are on foot slopes of the Pine Ridge.

Nearly all of this association supports native grasses and woodland and is primarily used for grazing. Most of the areas are generally too steep for cultivation. The shallow Tassel soils limit root development. Some of the more gently sloping soils on some broad ridgetops and foot slopes are cultivated. Dryland wheat and alfalfa are the main crops and are used mainly as winter feed for livestock.

The steep and very steep topography, the areas of Rock outcrop, and the shallow soils limit the use of most areas of this association to range, woodland, recreational areas, and wildlife habitat. This area provides good recreational sites and excellent habitat for deer, turkey, and other upland wildlife. It has good potential for the further development of wildlife habitat and recreational sites. Most of the association supports ponderosa pine and has good potential for commercial timber production.

Water erosion and soil blowing are the main hazards affecting cultivated areas. A system of conservation tillage that keeps protective amounts of crop residue on the surface and the use of cover crops help to control soil blowing and conserve moisture. The use of these soils as range effectively helps to control erosion. Proper grazing use, timely deferment of grazing, and a planned grazing system help to maintain or improve the range condition. Proper woodland management that improves the forest stands is a concern.

Soils Formed in Loess and Material Weathered from Calcareous Sandstone

Five associations are in this group. The soils formed in material weathered from calcareous sandstone, loamy and sandy eolian material, or local loamy

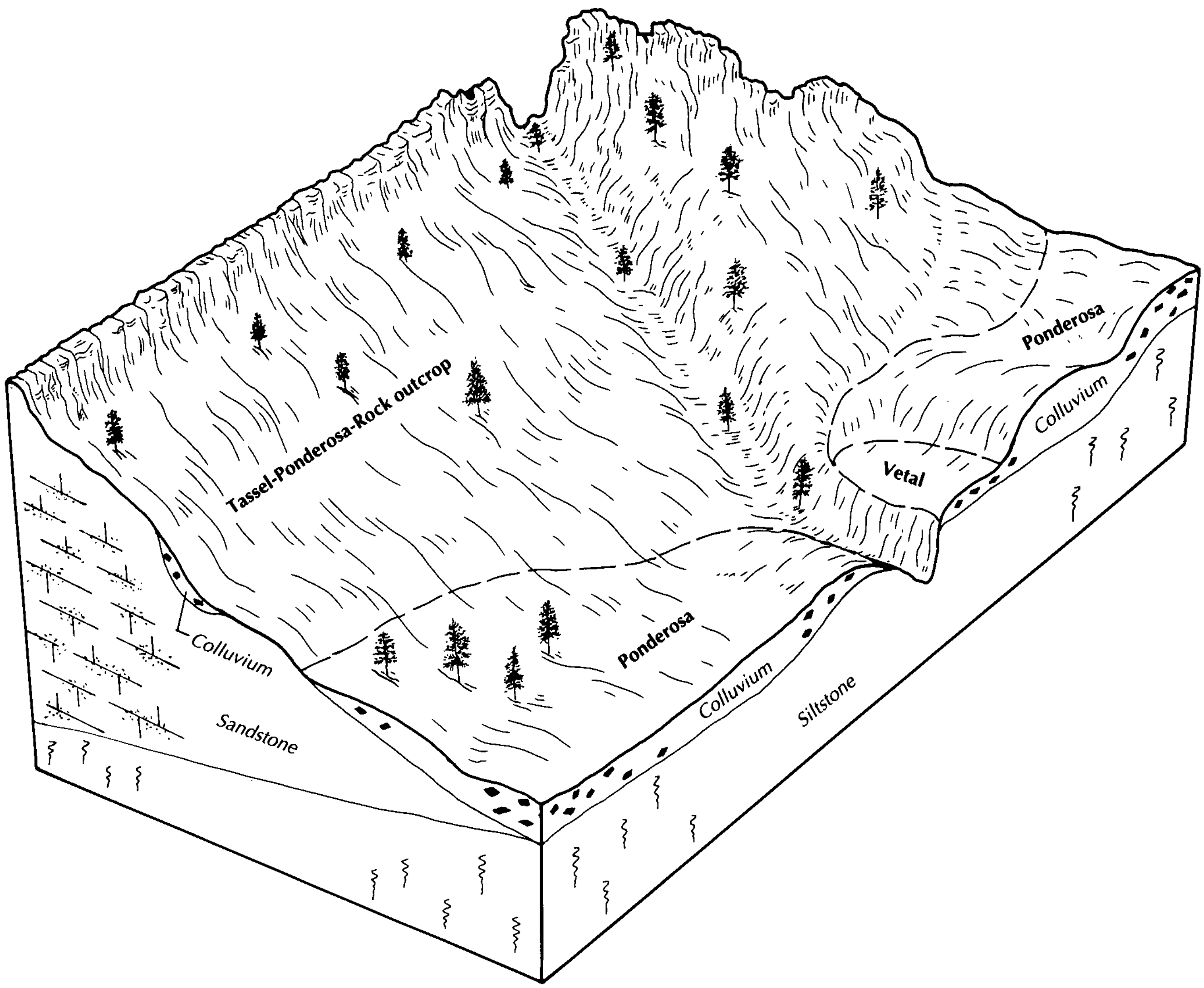


Figure 2.—Typical pattern of soils and parent material in the Tassel-Ponderosa-Rock outcrop association.

alluvial sediment on uplands. Most of the acreage of the soils in this group are cultivated. The rest supports native grasses used for grazing. Soil blowing and water erosion are the principal hazards.

4. Oglala-Alliance-Canyon association

Deep and shallow, nearly level to steep, well drained, loamy soils; on uplands

This association consists of nearly level to steep side slopes, ridgetops, and shoulders of uplands. It is on some of the highest elevations in the county and makes up the drainage divide between the White River to the north and the Niobrara River to the south.

This association makes up about 133,760 acres, or about 8 percent of the county. It is about 37 percent Oglala soils, 29 percent Alliance soils, 23 percent Canyon soils, and 11 percent minor soils (fig. 3).

The gently sloping to steep Oglala soils are on convex side slopes and rounded ridgetops. These soils are deep and well drained. They formed in loamy material weathered from calcareous sandstone. Typically, the surface layer is grayish brown, friable loam about 8 inches thick. The transitional layer is grayish brown, friable silt loam about 11 inches thick. The underlying material to a depth of 58 inches is light brownish gray, calcareous silt loam in the upper part and light gray, calcareous loam in the lower part.

Below a depth of 58 inches is white, calcareous sandstone.

The nearly level to gently sloping Alliance soils are on side slopes and broad ridgetops. These soils are deep and well drained. They formed in loess and the underlying calcareous sandstone. Typically, the surface layer is dark grayish brown, friable loam about 8 inches thick. The subsoil is about 15 inches thick. The upper part is grayish brown, firm silty clay loam; the middle part is pale brown, firm silty clay loam; and the lower part is pale brown, friable loam. The underlying material is light gray, calcareous very fine sandy loam to a depth of 49 inches. Below a depth of 49 inches is calcareous sandstone.

The gently sloping to steep Canyon soils are on narrow ridgetops and convex shoulders and the upper side slopes. These soils are shallow and well drained. They formed in loamy material weathered from calcareous sandstone. Typically, the surface layer is grayish brown, very friable very fine sandy loam about 5 inches thick. The transitional layer is light brownish gray, very friable loam about 5 inches thick. The underlying material is light gray very fine sandy loam to a depth of 14 inches. Below a depth of 14 inches is white, calcareous sandstone.

Of minor extent in this association are Rosebud, McCook, and Duroc soils. Rosebud soils are on landscapes similar to those of the Alliance soils and are moderately deep to bedrock. The very deep McCook soils are on bottom land and formed in recent alluvial material from the surrounding uplands. The very deep Duroc soils are on stream terraces, in upland swales, and on concave foot slopes and formed in alluvial and colluvial material.

Farms in this association are diversified, mainly a combination of cash-grain and livestock enterprises. The nearly level to strongly sloping areas generally are cultivated. The steep areas and some of the strongly sloping areas generally support native grasses and are used for grazing. The shallow Canyon soils limit

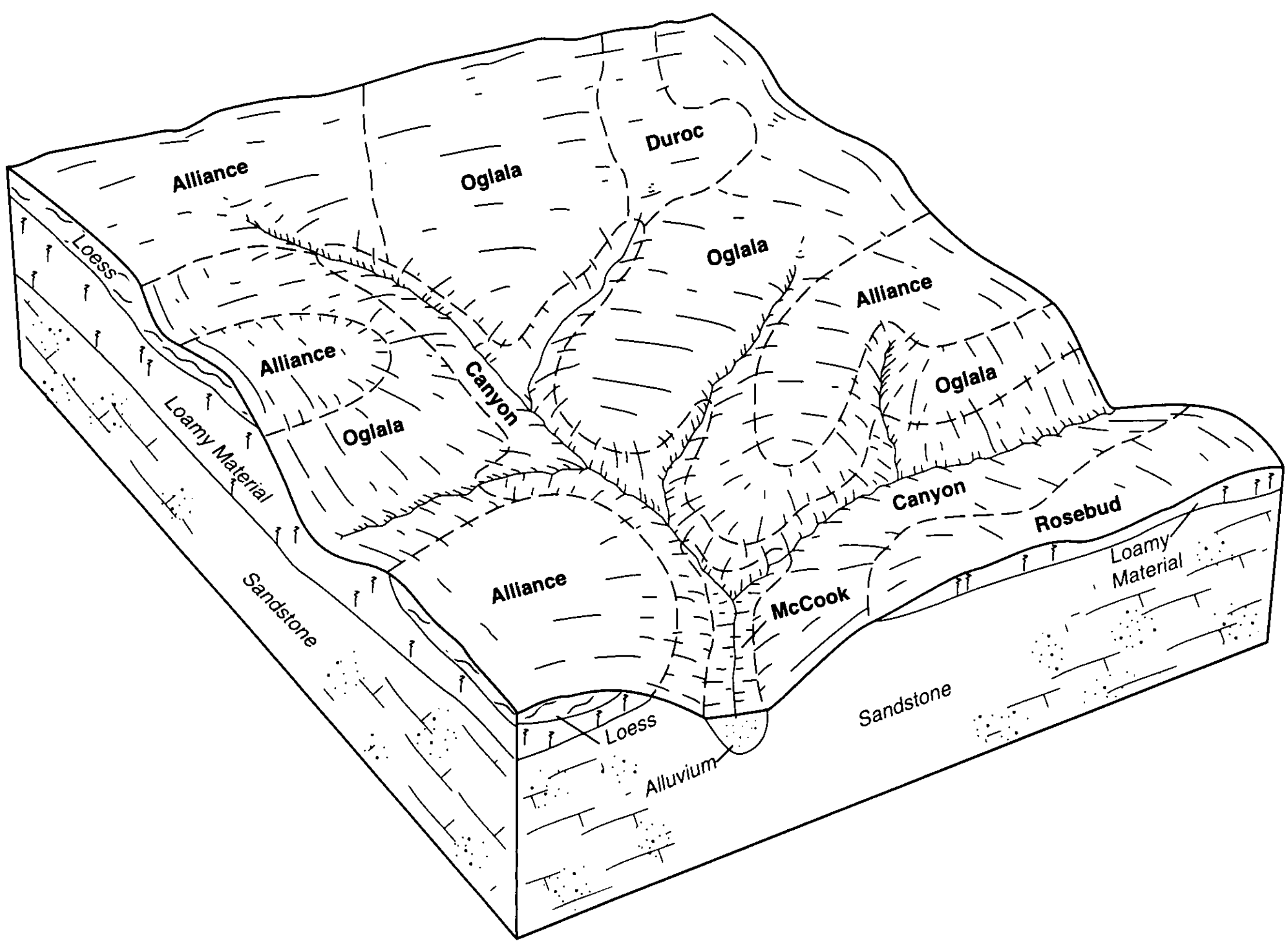


Figure 3.—Typical pattern of soils and parent material in the Oglala-Alliance-Canyon association.

root development. The main dryland crops are wheat, alfalfa, oats, and millet. A few areas are irrigated, and corn and alfalfa are the main crops.

Water erosion and soil blowing are the main hazards affecting cultivated areas. A system of conservation tillage that leaves crop residue on the surface and the use of cover crops help to control erosion and conserve moisture.

5. Satanta-Canyon-Busher association

Very deep, deep, and shallow, nearly level to steep, well drained, loamy soils; on uplands

This association consists mainly of soils on side slopes, shoulders, and ridgetops. Many areas are dissected by drainageways. Slopes range from 0 to 30 percent.

This association makes up about 71,040 acres, or about 4 percent of the county. It is about 32 percent Satanta soils, 22 percent Canyon soils, 13 percent Busher soils, and about 33 percent minor soils.

The nearly level to strongly sloping Satanta soils are on broad ridgetops and side slopes of uplands. They are very deep and well drained. They formed in loamy eolian material. Typically, the surface layer is dark grayish brown, very friable fine sandy loam about 9 inches thick. The subsurface layer is similar to the surface layer in color and texture and is about 5 inches thick. The subsoil is about 21 inches thick. It is grayish brown and pale brown, firm sandy clay loam in the upper part and light gray, calcareous, friable loam in the lower part. The underlying material is light gray very fine sandy loam and fine sandy loam to a depth of more than 60 inches.

The gently sloping to steep Canyon soils are on narrow ridgetops, shoulders, and convex side slopes of uplands. They are shallow and well drained. They formed in loamy material weathered from calcareous sandstone. Typically, the surface layer is grayish brown, very friable loam about 5 inches thick. The transitional layer is light brownish gray, very friable loam about 5 inches thick. The underlying material is light gray very fine sandy loam to a depth of 14 inches. Below this to a depth of more than 60 inches is white, calcareous sandstone.

The nearly level to steep Busher soils are on the lower side slopes and ridgetops. They are deep and well drained. They formed in material weathered from calcareous sandstone. Typically, the surface soil is dark grayish brown and brown, very friable fine sandy loam about 10 inches thick. The subsoil is brown, very friable fine sandy loam about 8 inches thick. The underlying material to a depth of 44 inches is pale brown fine sandy loam in the upper part and white, calcareous loamy very fine sand in the lower part. Below this to a depth of more than 60 inches is white, calcareous sandstone.

Of minor extent in this association are Alliance, Dailey, Duroc, Jayem, Keith, Keya, Lodgepole, Munjor, Tuthill, and Vetal soils. Alliance soils have calcareous sandstone bedrock at a depth of 40 to 60 inches and are on landscapes similar to those of the Satanta soils. Dailey and Jayem soils have less clay in the subsoil than the Satanta soils and are on similar landscapes. Tuthill soils have loamy fine sand or fine sand at a depth of 20 to 40 inches and are on landscapes similar to those of the Satanta soils. Keith soils have less sand in the subsoil than the Satanta soils and are on similar landscapes. Munjor and Vetal soils are coarser textured than the major soils. Keya and Duroc soils have a dark surface layer more than 20 inches thick and are lower on the landscape than the Satanta and Canyon soils. Lodgepole soils have a dark surface layer more than 20 inches thick and are in shallow depressions.

Farms in this association are diversified, with winter wheat and cattle as the main enterprises. In areas that are irrigated by a sprinkler or a gravity system, dry, edible beans; corn; and alfalfa are grown. The shallow Canyon soils limit root development for cultivated crops. Cattle and grain are marketed locally or in adjacent counties. A system of conservation tillage that keeps protective amounts of crop residue on the surface and the use of cover crops help to control erosion. Proper grazing use, timely deferment from grazing, and a planned grazing system help improve or maintain the range condition.

6. Tuthill-Keya association

Very deep, nearly level to strongly sloping, well drained, loamy and sandy soils; on uplands

This association consists of soils on uplands and in upland swales. Slopes range from 0 to 11 percent.

This association makes up 126,080 acres, or about 8 percent of the county. It is 63 percent Tuthill soils, 25 percent Keya soils, and about 12 percent minor soils.

The nearly level to strongly sloping Tuthill soils are on uplands. They are very deep and well drained. They formed in sandy and loamy material of mixed origin. Typically, the surface layer is dark grayish brown, very friable fine sandy loam or loamy fine sand about 9 inches thick. The subsoil is dark brown and brown, firm sandy clay loam about 12 inches thick. The

underlying material to a depth of more than 60 inches is pale brown loamy fine sand in the upper part and very pale brown fine sand in the lower part.

The nearly level Keya soils are in upland swales. They are very deep and well drained. They formed in local loamy alluvium. Typically, the surface layer is dark grayish brown, friable loam about 6 inches thick. The subsurface layer is similar to the surface layer in color and texture and is about 11 inches thick. The subsoil is about 32 inches thick. It is dark grayish brown and grayish brown, firm clay loam in the upper part and pale brown, friable, calcareous loam in the lower part. The underlying material is very pale brown, calcareous loam to a depth of more than 60 inches.

Of minor extent in this association are Busher, Dailey, Valent, and Vetal soils. Busher soils have calcareous sandstone bedrock above a depth of 60 inches and are on landscapes similar to those of the Tuthill soils. Dailey and Valent soils have less clay in the profile than the Tuthill soils and are on similar landscapes. Vetal soils have less clay in the profile than the Keya soils and are on similar landscapes.

Farms in this association are diversified grain and livestock enterprises. Winter wheat and alfalfa are the main crops. Some cultivated areas are planted to sunflowers and millet. Some areas support native grasses and are used as range. Grain and cattle are marketed locally or in adjacent counties. Alfalfa is used as winter feed for cattle.

Erosion is the main hazard in cultivated areas. A system of conservation tillage that keeps protective amounts of crop residue on the surface and the use of cover crops help to control erosion and conserve moisture. Proper grazing use, timely deferment of grazing, and a planned grazing system help improve or maintain the range condition.

7. Busher-Tassel association

Deep and shallow, nearly level to steep, well drained, loamy soils; on uplands

This association consists mainly of soils on ridgetops, shoulders, side slopes, and breaks on uplands. Slopes range from 0 to 30 percent.

This association makes up about 10,880 acres, or less than 1 percent of the county. It is about 38 percent Busher soils, about 20 percent Tassel soils, and about 42 percent minor soils.

The nearly level to steep Busher soils are on the lower side slopes and ridgetops. They are deep and well drained. They formed in material weathered from calcareous sandstone. Typically, the surface soil is dark grayish brown and brown, very friable fine sandy loam about 10 inches thick. The subsoil is brown, very friable fine sandy loam about 8 inches thick. The underlying material to a depth of 44 inches is pale brown, calcareous fine sandy loam in the upper part and white loamy very fine sand in the lower part. Below this to a depth of more than 60 inches is white, calcareous sandstone.

The strongly sloping to steep Tassel soils are on shoulders and the upper side slopes on uplands. They are shallow and well drained. They formed in loamy material weathered from calcareous sandstone. Typically, the surface layer is dark grayish brown, very friable, calcareous fine sandy loam about 3 inches thick. The underlying material is light brownish gray, calcareous fine sandy loam to a depth of 10 inches. Below this to a depth of more than 60 inches is white, calcareous sandstone.

Of minor extent in this association are Canyon, Dailey, Jayem, Satanta, Valent, and Vetal soils. Canyon soils have more clay than the Tassel soils and are on similar landscapes. Dailey, Jayem, Satanta, and Valent soils do not have calcareous sandstone above a depth of 60 inches and are on landscapes similar to those of the Busher soils. Vetal soils do not have bedrock above a depth of 60 inches and are lower on the landscape than the Busher soils.

The soils in this association support native grasses and are used as range. They are not suitable for cultivation because of the slope, the shallow root zone, and the hazard of erosion. The use of these soils as range helps to control erosion. Proper grazing use, timely deferment of grazing, and a planned grazing system help improve or maintain the range condition. Livestock are sold locally or in adjacent counties.

8. Busher-Valent-Tassel association

Very deep, deep, and shallow, nearly level to very steep, well drained and excessively drained, loamy and sandy soils; on uplands

This association is on breaks, dunes, and ridges on uplands and on side slopes adjacent to upland drainageways. Most of the intermittent drainageways are tributaries of the Niobrara River.

This association makes up about 3,520 acres, or less than 1 percent of the county. It is about 27 percent Busher soils, 24 percent Valent soils, 14 percent Tassel soils, and 35 percent minor soils.

The nearly level to steep Busher soils are on smooth side slopes and ridgetops between upland drainageways. These soils are deep and well drained. They formed in material weathered from calcareous sandstone. Typically, the surface layer is very friable

fine sandy loam about 10 inches thick. It is dark grayish brown in the upper part and dark brown in the lower part. The subsoil is brown, very friable fine sandy loam about 8 inches thick. The underlying material to a depth of 44 inches is pale brown, calcareous fine sandy loam in the upper part and white, calcareous loamy very fine sand in the lower part. Below this to a depth of 60 inches is calcareous sandstone.

The nearly level to very steep Valent soils are on dunes in the sandhills. These soils are very deep and excessively drained. They formed in eolian sand. Typically, the surface layer is grayish brown, loose fine sand or loamy fine sand about 4 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches.

The strongly sloping to steep Tassel soils are on ridgetops, breaks, and the upper side slopes along intermittent drainageways. These soils are shallow and well drained. They formed in loamy material weathered from sandstone. Typically, the surface layer is dark grayish brown, very friable, calcareous fine sandy loam about 3 inches thick. The underlying material is light brownish gray, calcareous fine sandy loam to a depth of about 10 inches. Below this to a depth of 60 inches is white, calcareous sandstone.

Of minor extent in this association are Jayem, Oglala, and Vetal soils. The nearly level to strongly sloping Jayem soils are on uplands. The gently sloping to steep Oglala soils are on side slopes on the uplands. Vetal soils are in upland swales.

This association mainly supports native grasses used for grazing. Some areas of the less sloping soils are farmed. Winter wheat is the main dryland crop, and corn and alfalfa are the main irrigated crops.

Water erosion is the principal hazard affecting areas used for range, and soil blowing is the principal hazard affecting cultivated areas. Insufficient rainfall in summer generally limits the growth of grasses and cultivated crops. A restrictive layer in some of the soils limits root growth and the available water capacity for the production of grasses and crops. Regulating the timing and intensity of grazing and improving the range condition are the principal management concerns affecting range. Controlling soil blowing and improving fertility are the management concerns affecting cultivated areas.

Farms and ranches in this association average about 2,000 acres. Many of the owners or operators live outside this association. Wells provide sufficient water for livestock and domestic uses. Cattle is the main livestock enterprise, and most cattle are marketed outside the county at local sale barns or at larger terminal markets. Some of the yearling calves are sold directly to feeder buyers. Cash-grain crops are marketed locally. Very few improved roads are in this association. Trails provide access to most areas.

Areas of Soils Formed in Mixed Loess and Alluvium and Areas of Rock Outcrop

Three associations are in this group. These soils formed in material weathered from mixed loess and alluvium on upland stream terraces and on bottom land adjacent to the Niobrara River. Most of the acreage of the soils in this group support native grasses and are used as range. Most of the soils in the Mirage Flats area are irrigated. Soil blowing and water erosion are the principal hazards affecting cultivated areas.

9. Keith, gravelly substratum-Bridget-Johnstown association

Very deep, nearly level to gently sloping, well drained, loamy soils; on uplands, foot slopes, and alluvial fans

This association consists mainly of soils on uplands adjacent to the Niobrara River. Slopes range from 0 to 6 percent.

This association makes up about 24,960 acres, or about 2 percent of the county. It is 50 percent Keith, gravelly substratum, soils; 25 percent Bridget soils; 19 percent Johnstown soils; and about 6 percent minor soils.

The Keith, gravelly substratum, soils are nearly level to gently sloping and formed in loess over gravelly sediment on uplands. They are very deep and well drained. Typically, the surface soil is dark grayish brown, friable loam about 12 inches thick. The subsoil is about 18 inches thick. It is grayish brown, friable clay loam in the upper part and light brownish gray, friable silt loam in the lower part. The underlying material is light gray, calcareous loam to a depth of 49 inches. Below this to a depth of more than 60 inches is white, calcareous gravelly coarse sand.

The Bridget soils are nearly level and very gently sloping and formed in loamy colluvial and alluvial sediments. They are on foot slopes and alluvial fans. These soils are very deep and well drained. Typically, the surface soil is grayish brown loam about 9 inches thick. The transitional layer is light brownish gray, very friable, calcareous loam about 6 inches thick. The underlying material is calcareous, light gray loam to a depth of more than 60 inches.

The Johnstown soils are nearly level and formed in loess and loamy sediment over gravelly sand. They are on uplands. They are very deep and well drained.

Typically, the surface soil is dark grayish brown loam about 11 inches thick. The subsoil is about 26 inches thick. It is grayish brown, dark grayish brown, and pale brown, firm silty clay loam in the upper part and light gray, friable, calcareous loam in the lower part. The underlying material is light gray, calcareous loam to a depth of 43 inches. Below this to a depth of more than 60 inches is light gray, calcareous gravelly coarse sand.

Of minor extent in this association are Satanta and Beckton soils. Satanta soils are not underlain by gravelly coarse sand and are higher on the landscape than the Johnstown soils. The alkali-affected Beckton soils are lower on the landscape than the Bridget soils.

Farms in this association produce winter wheat. In irrigated areas corn and dry, edible beans are the main crops.

Water erosion and soil blowing are the main hazards. A system of conservation tillage and the use of cover crops help to control erosion and conserve moisture. Farm produce is marketed mainly within the county or in adjacent counties.

10. Beckton-Lute association

Very deep, nearly level, moderately well drained and somewhat poorly drained, loamy soils; on alluvial fans and low stream terraces

This association consists of soils on alluvial fans and low stream terraces that have a high content of sodium. Slopes range from 0 to 2 percent.

This association is about 24,320 acres, or about 2 percent of the county. It is 56 percent Beckton soils, 25 percent Lute soils, and 19 percent minor soils.

Beckton soils are very deep, moderately well drained, and nearly level. They formed in loamy alluvium. Typically, the surface layer is dark grayish brown, very friable silt loam about 5 inches thick. The subsurface layer is light gray, very friable silt loam about 3 inches thick. The subsoil is about 27 inches thick. It is grayish brown, firm silty clay loam in the upper part and brown, very friable, calcareous silt loam in the lower part. The underlying material is light gray, calcareous silt loam to a depth of more than 60 inches.

Lute soils are very deep, somewhat poorly drained, and nearly level. They formed in loamy alluvium. Typically, the surface layer is dark gray, friable loam about 6 inches thick. The subsurface layer is light brownish gray loam about 1 inch thick. The subsoil is about 17 inches thick. It is gray, firm, calcareous sandy clay loam in the upper part and grayish brown, very friable, calcareous very fine sandy loam in the lower part. The underlying material is light gray, calcareous very fine sandy loam to a depth of more than 60 inches.

Of minor extent in this association are Busher, Calamus, Munjor, Jayem, Keya, Tryon, and Vetal soils. The minor soils do not contain sodium and are higher on the landscape than the major soils.

Nearly all of this association supports native grasses used as range or hayland. Some areas are used as cropland.

Farms in this association are diversified cattle and grain enterprises. Winter wheat is the main cultivated crop and is grown mainly in the areas that are least affected by sodium. Some alfalfa also is grown.

The use of the soils in this association as range or hayland is effective in controlling soil erosion. In cultivated areas a system of conservation tillage that keeps protective amounts of crop residue on the surface and the use of cover crops help to control water erosion and soil blowing and conserve moisture. Crops are marketed locally or in adjacent counties.

11. Orpha-Calamus-Rock outcrop association

Areas of Rock outcrop and very deep, nearly level to very steep, excessively drained and moderately well drained, sandy soils; on uplands, foot slopes, and bottom land

This association consists mainly of the valley sides and valley floor along the Niobrara River. Slopes range from 0 to 60 percent.

This association makes up about 62,080 acres, or about 4 percent of the county. It is about 48 percent Orpha soils, 15 percent Calamus soils, 14 percent areas of Rock outcrop, and about 23 percent minor soils (fig. 4).

The gently sloping to very steep Orpha soils are on side slopes and foot slopes. They are very deep and excessively drained. They formed in sandy material weathered from sandstone. Typically, the surface layer is grayish brown loamy fine sand about 6 inches thick. The transitional layer is light brownish gray sand about 4 inches thick. The underlying material is light gray sand and fine sand to a depth of more than 60 inches. It is calcareous in the lower part.

The nearly level to very gently sloping Calamus soils are on bottom land along the Niobrara River and its tributaries. They are very deep and moderately well drained. They formed in sandy alluvium and are rarely flooded. Typically, the surface layer is grayish brown loamy fine sand about 9 inches thick. The transitional layer is light brownish gray fine sand about 9 inches

Figure 4.—Typical area of the Orpha-Calamus-Rock outcrop association.

thick. The underlying material is light gray fine sand to a depth of more than 60 inches. The lower part is mottled and stratified with loamy fine sand and fine sandy loam.

Areas of Rock outcrop are in the steepest areas on the upper side slopes. Rock outcrop is calcareous sandstone.

Of minor extent in this association are Almeria, Bolent, Jayem, Lute, Tryon, and Vetal soils. Almeria soils are poorly drained and are on bottom land along the Niobrara River and Rush Creek. Bolent soils are somewhat poorly drained and are on bottom land along the Niobrara River and Rush Creek. Lute soils have a high content of sodium and are on low stream terraces and alluvial fans. Jayem, Tryon, and Vetal soils have a dark surface soil and are lower on the landscape than the Orpha soil.

The soils in this association mainly support native grasses and are used as range. The Orpha soils are generally too steep for cultivation. The Calamus soils are subject to rare flooding and the hazard of soil blowing. Some areas of the Calamus soils are used for native hay, but in a few areas alfalfa is grown for use as winter feed. Cattle are marketed locally or in adjacent counties.

Soils Formed in Sandy Eolian Material and Sandy Alluvium

Five associations are in this group. These soils formed in eolian sand and sandy alluvium in the sandhills. Nearly all of the acreage of the soils in this group support native grasses and are used as range and hayland. A few small areas are cultivated. Soil blowing is the principal hazard. Regulating the timing and intensity of grazing and maintaining or improving

the range condition are the principal concerns affecting rangeland. Soil blowing is the main management concern affecting cultivated areas.

12. Valent-Dailey association

Very deep, nearly level to rolling, excessively drained and somewhat excessively drained, sandy soils; in the sandhills

This association is in the sandhills and consists of hummocks and smooth side slopes.

This association makes up about 92,160 acres, or 6 percent of the county. It is 50 percent Valent soils, 35 percent Dailey soils, and 15 percent minor soils (fig. 5).

The nearly level to rolling Valent soils are on dunes in the sandhills. These soils are very deep and excessively drained. They formed in eolian sand. Typically, the surface layer is grayish brown, loose fine sand or loamy fine sand about 4 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches.

The nearly level to strongly sloping Dailey soils are in sandhill valleys. These soils are very deep and somewhat excessively drained. They formed in eolian sand. Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 15 inches thick. The transitional layer is pale brown, very friable fine sand about 11 inches thick. The underlying material is light yellowish brown and very pale brown fine sand to a depth of more than 60 inches.

Of minor extent in this association are Jayem, Satanta, Tuthill, and Vetal soils. Jayem, Satanta, and Tuthill soils are well drained and are on landscapes similar to those of the Dailey soils. Vetal soils are well drained and are lower on the landscape than the Dailey soils.

Farms and ranches in this association mainly support native grasses and are used as range. The less sloping areas are cultivated. Corn and alfalfa are grown in irrigated areas. Winter wheat is the main dryland crop.

Soil blowing is the principal hazard in cultivated areas or in overgrazed areas that are unprotected by a plant cover.

Cattle and cash-grain crops are marketed locally or in adjacent counties. Alfalfa is used as winter feed.

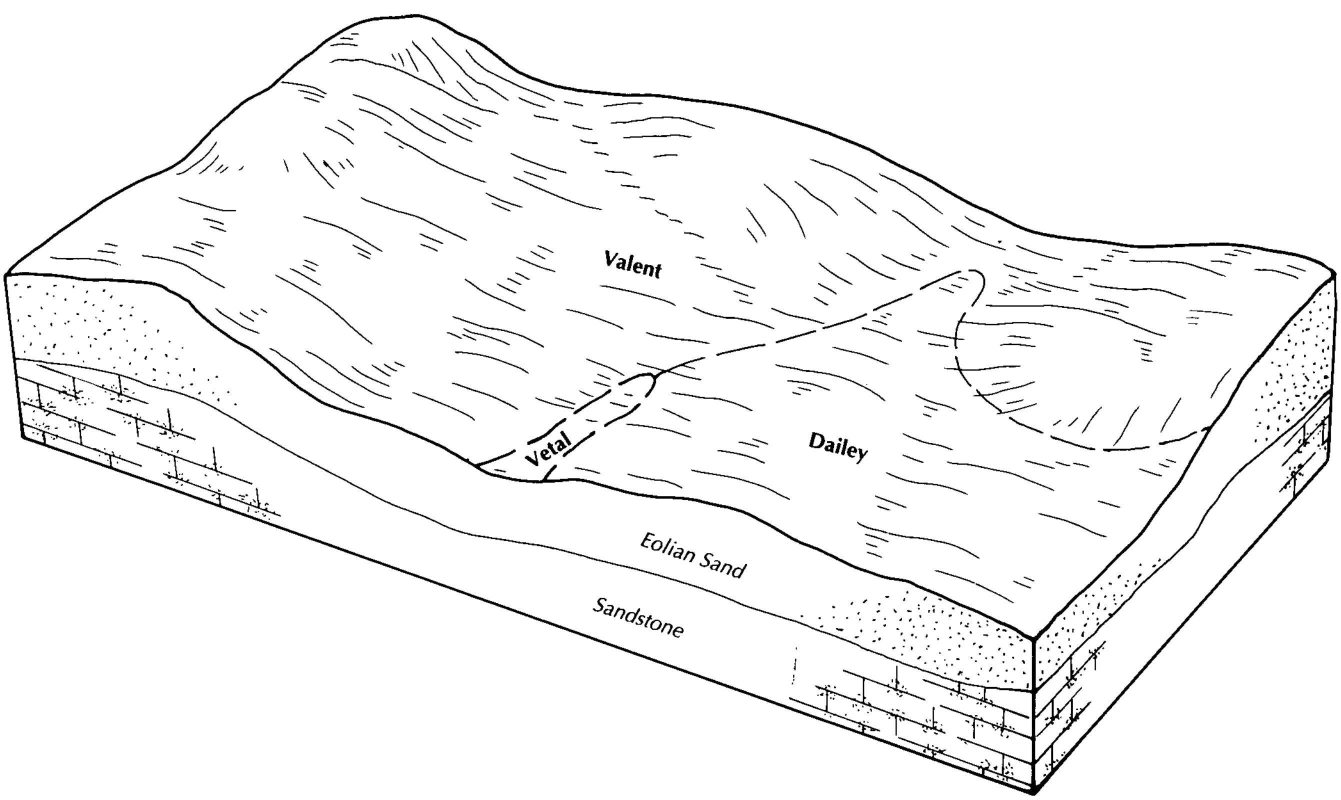


Figure 5.—Typical pattern of soils and parent material in the Valent-Dailey association.

13. Valent association

Very deep, rolling and hilly, excessively drained, sandy soils; in the sandhills

This association consists of sandhills. The rolling and hilly dunes are interspersed with gently undulating and undulating dunes. Catsteps are common on the steepest slopes.

This association makes up about 413,229 acres, or about 26 percent of the county. It is about 96 percent Valent soils and 4 percent minor soils and lakes (fig. 6).

Valent soils are very deep and excessively drained. They formed in eolian sand. Typically, the surface layer is grayish brown, loose fine sand about 4 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches.

Of minor extent in this association are Dailey; Els, calcareous; Gannett; Hoffland; and Ipage soils and areas of small lakes. Dailey soils are on the lower side slopes and in dry sandhill valleys and have a dark surface soil more than 10 inches thick. Els, calcareous; Gannett; Hoffland; and Ipage soils are in sandhill valleys. Els, calcareous, soils are somewhat poorly drained. Hoffland and Gannett soils are poorly drained and very poorly drained. Ipage soils are moderately well drained. Small lakes are in some of the depressions.

Nearly all of this association supports native grasses and is used for range and hayland. The rolling and hilly areas are used for range, and the nearly level and gently undulating areas are used for range and as hayland. A small acreage of the nearly level to gently sloping areas is cultivated. Corn, mixed grasses, and alfalfa are grown. Nearly all of the cultivated areas are irrigated by center-pivot or other sprinkler systems.

Ranching is well adapted to the soils in this association. Management that includes proper grazing use, timely deferment of grazing or haying, and a grazing system in which the order of grazing and rest periods are changed each year helps to maintain or improve the range condition. Erosion is the main hazard affecting cultivated areas. A system of

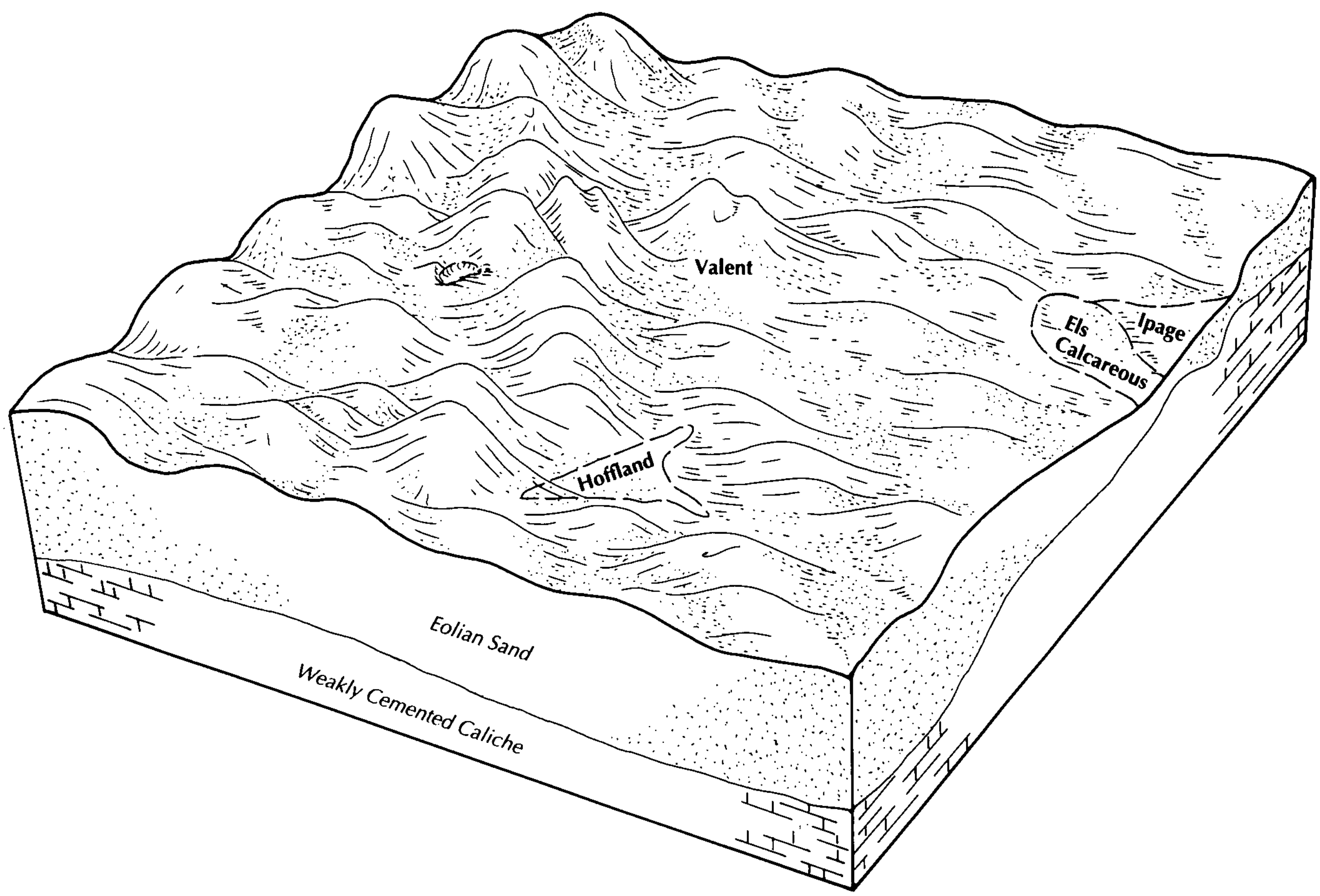


Figure 6.—Typical pattern of soils and parent material in the Valent association.

conservation tillage that leaves crop residue on the surface helps to control erosion. In irrigated areas, timely application of irrigation water and improvement of fertility are the main management concerns.

Cattle and cash-grain crops are marketed locally or in adjacent counties. Alfalfa is used as winter feed.

14. Valent-Wildhorse association

Very deep, nearly level to hilly, excessively drained and somewhat poorly drained, sandy soils; in the sandhills

This association consists of sandhills interspersed with valleys. The dunes range as much as 300 feet above the valley floors. The dunes on the north side of the valleys are generally very steep and have catsteps, and those on the south side of the valleys are generally rounded and smoother. The valleys are nearly level and very gently sloping. They have numerous lakes and wet areas that are surrounded by better drained soils.

This association makes up about 238,720 acres, or about 15 percent of the county. It is about 60 percent Valent soils, 20 percent Wildhorse soils, and 20 percent minor soils and lakes (fig. 7).

The nearly level to hilly Valent soils are on dunes and in sandhill valleys. They are very deep and excessively drained. They formed in eolian sand. Typically, the surface layer is grayish brown, loose fine sand about 4 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches.

The nearly level and very gently sloping Wildhorse soils are in sandhill valleys. They are very deep and somewhat poorly drained. These soils have a high content of sodium. They formed in eolian sand and sandy alluvium. Typically, the surface layer is grayish brown, very friable, calcareous fine sand about 5 inches thick. The transitional layer is light brownish gray, calcareous fine sand about 5 inches thick. The underlying material is light brownish gray and light gray, calcareous fine sand to a depth of more than 60 inches.

Of minor extent in this association are Crowther, Dailey, Hoffland, Ipage, and Marlake soils and areas of lakes in the sandhills. Crowther and Hoffland soils are poorly drained and very poorly drained and are lower on the landscape than the Wildhorse soils. Dailey soils are somewhat excessively drained. They are higher on the landscape than the Wildhorse soils. Ipage soils are moderately well drained and are in sandhill valleys. They are slightly higher on the landscape than the Wildhorse soils. Marlake soils are very poorly drained and are in depressions that are ponded for most of the year. They are commonly at the edges of lakes. Lakes are in the lowest parts of some of the depressions.

Nearly all of this association supports native grasses and is used for range and hayland. The rolling and hilly areas are used for range, and the larger, wet valleys are used mainly for the production of native hay. In a few cultivated areas sprinkler irrigation systems are used. Alfalfa and mixed grasses are grown.

Ranching is well adapted to the soils in this association. Management that includes proper grazing use, timely deferment of grazing or haying, and a grazing system in which the order of the grazing and rest periods are changed each year helps to maintain or improve the range condition. In cultivated areas control of soil blowing, timely application of irrigation water, and improvement of fertility are the main management concerns.

Cattle are marketed in local sale barns, sold directly to feeder operations, or hauled by truck to large terminal markets.

15. Valent-Els, calcareous-Hoffland association

Very deep, nearly level to hilly, excessively drained, somewhat poorly drained, poorly drained, and very poorly drained, sandy and loamy soils; in the sandhills

This association consists of sandhills and wet valleys. The hills are as much as 400 feet above the valley floors and are generally steep and very steep on the north side of the valleys. Catsteps are common on the steepest slopes. The valleys are nearly level and very gently sloping and are interspersed with lakes.

This association makes up about 117,120 acres, or about 7 percent of the county. It is about 76 percent Valent soils; 10 percent Els, calcareous, soils; 6 percent Hoffland soils; and 8 percent minor soils and lakes.

The nearly level to hilly Valent soils are on dunes in the sandhills. They are very deep and excessively drained. They formed in eolian sand. Typically, the surface layer is grayish brown, loose fine sand about 4 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches.

The nearly level and very gently sloping Els, calcareous, soils are in sandhill valleys. They are very deep and somewhat poorly drained. They formed in eolian sand and sandy alluvium. Typically, the surface layer is gray, very friable, calcareous fine sand about 7 inches thick. The transitional layer is grayish brown,

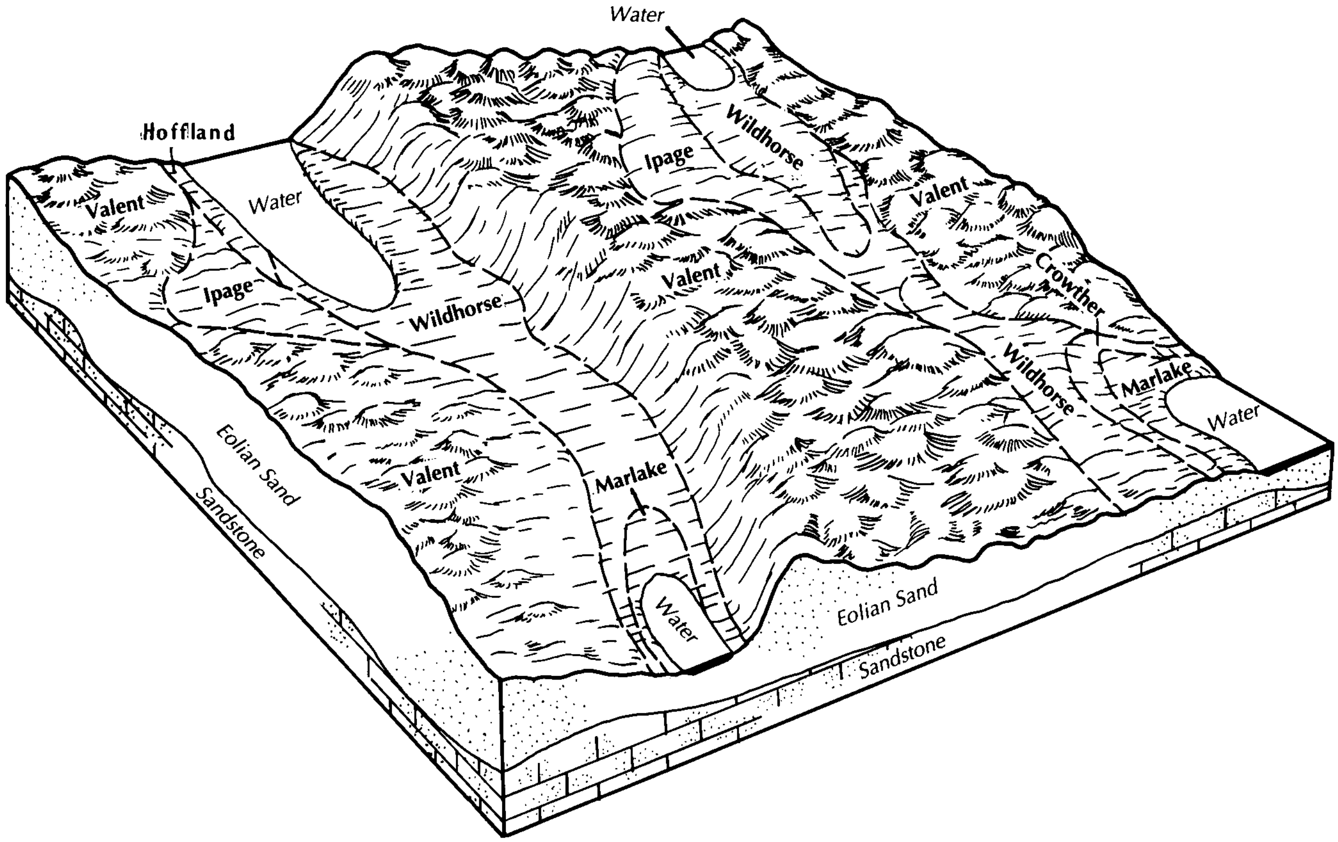


Figure 7.—Typical pattern of soils and parent material in the Valent-Wildhorse association.

very friable fine sand about 6 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches.

The nearly level Hoffland soils are in sandhill valleys. They are very deep and are poorly drained and very poorly drained. They formed in sandy alluvium. Typically, the surface layer is gray, very friable, calcareous fine sandy loam about 4 inches thick. The subsurface layer is friable, calcareous fine sandy loam about 7 inches thick. It is gray in the upper part and light brownish gray in the lower part. The underlying material to a depth of 60 inches or more is fine sand. The upper part is light brownish gray and is mottled, and the lower part is light gray and is stratified with fine sandy loam.

Of minor extent in this association are Elsmere, Ipage, Marlake, Tryon, and Wildhorse soils and areas of lakes in the sandhills. Elsmere soils are somewhat poorly drained and have a dark surface soil more than 10 inches thick. They are on landscapes similar to those of the Els, calcareous, soils. Tryon soils are poorly drained and very poorly drained and are lower on the landscape than the Els, calcareous, soils. Ipage soils are moderately well drained. They are slightly higher on the landscape than the Els, calcareous, soils and are lower on the landscape than the Valent soils. Marlake soils are very poorly drained and are in depressions that are ponded for most of the year. Wildhorse soils have a high content of sodium and are on landscapes similar to those of the Els, calcareous, soils. Lakes are in some of the depressions.

Nearly all of this association supports native grasses and is used for range and hayland. The rolling and hilly areas are used for range, and the wet valleys are used mainly for the production of native hay. In a few small cultivated areas sprinkler irrigation systems are used. Alfalfa is the principal crop.

Ranching is well adapted to the soils in this association. Maintaining desirable grasses through a grazing system in which the order of the grazing and rest periods are changed every year and establishing adequate and proper placement of water facilities are the main management concerns. In cultivated areas timely application of irrigation water, control of soil blowing, and improvement of fertility are the main management concerns.

Cattle are marketed in local sale barns, sold directly to feeder operations, or hauled by truck to large terminal markets.

16. Valentine-Tryon-Ipage association

Very deep, nearly level to hilly, excessively drained, moderately well drained, poorly drained, and very poorly drained, sandy and loamy soils; in the sandhills

This association consists of hummocky sandhills with intervening wet valleys. Slopes range from 0 to 60 percent. The soils in this association formed in eolian sand and alluvium.

This association makes up 76,160 acres, or about 5 percent of the county. It is about 55 percent Valentine soils, 17 percent Tryon soils, 11 percent Ipage soils, and 17 percent minor soils.

The gently sloping to hilly Valentine soils are on dunes in the sandhills. They are very deep and excessively drained. They formed in eolian sand. Typically, the surface layer is pale brown, loose fine sand about 6 inches thick. The underlying material is very pale brown fine sand to a depth of more than 60 inches.

The nearly level Tryon soils are in sandhill valleys. They are very deep and are poorly drained and very poorly drained. They formed in eolian sand and sandy alluvium. Typically, the surface layer is very dark grayish brown, very friable fine sandy loam about 6 inches thick. The underlying material extends to a depth of more than 60 inches. The upper part is light brownish gray fine sand, the middle part is mottled, light brownish gray loamy fine sand, and the lower part is light gray fine sand.

The nearly level and very gently sloping Ipage soils are in sandhill valleys. They are very deep and moderately well drained. They formed in eolian sand. Typically, the surface layer is dark grayish brown, loose fine sand about 5 inches thick. The transitional layer is grayish brown, loose fine sand about 6 inches thick. The underlying material to a depth of more than 60 inches is light brownish gray in the upper part and mottled pale brown in the lower part.

Of minor extent in this association are Els, calcareous; Elsmere; Gannett; and Marlake soils. Els, calcareous, and Elsmere soils are somewhat poorly drained and are in sandhill valleys. Gannett soils are poorly drained and very poorly drained and have a loamy surface layer and subsurface layer. They are in sandhill valleys. Marlake soils are in depressions in sandhill valleys and are ponded for most of the year.

Nearly all of this association supports native grasses used for range and hayland. The subirrigated valleys are used as hayland. Most of this association is unsuited to cultivated crops because of the slope and the wetness of the valleys. Ranches in this association are predominantly cow-calf livestock enterprises. Wells provide good-quality water for livestock.

Overgrazing can reduce the protective cover and result in deterioration of the native plants. Management that includes proper grazing use, timely deferment of grazing and haying, and restricted use during very wet periods helps to maintain or improve the range condition. The seasonal high water table benefits grasses during dry periods but hinders haying during wet periods. Soil blowing can be controlled by an adequate plant cover.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under the heading "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alliance loam, 1 to 3 percent slopes, is a phase of the Alliance series.

Some map units are made up of two or more major soils. These map units are called soil complexes or soil associations.

A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Oglala-Canyon complex, 11 to 30 percent slopes, is an example.

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. Tassel-Ponderosa-Rock outcrop association, 9 to 70 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Badland is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Some soil boundaries and soil names in this survey do not fully match those in the surveys of adjoining counties that were published at an earlier date. Differences are the result of changes and refinements in series concepts, variations in slope groupings, and application of the latest classification system.

Soil Descriptions

Ac—Alliance loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on uplands. It formed in loess and the underlying calcareous sandstone. Areas range from 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable loam about 6 inches thick. The subsurface

layer is grayish brown, very friable loam about 4 inches thick. The subsoil is about 13 inches thick. The upper part is grayish brown, friable silty clay loam. The middle part is light brownish gray, friable silty clay loam, and the lower part is light gray, friable loam. The underlying material is white, very friable loam to a depth of 53 inches. Below this to a depth of 60 inches or more is white, calcareous sandstone. In some places calcareous sandstone is at a depth of 20 to 40 inches. In other places the surface layer is silt loam.

Included with this soil in mapping are small areas of Duroc soils, which have a dark surface soil more than 20 inches thick and are in slightly concave areas. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Alliance soil. Available water capacity is high. The organic matter content is moderate. Runoff is slow. The water intake rate is moderately low.

Nearly all of the acreage of this soil is cultivated. About half of the acreage is used for dryland farming, and the rest is used as irrigated cropland. A few areas are used for range.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Soil blowing is a slight hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to conserve soil moisture and control soil blowing. Cover crops also help to control soil blowing. Returning crop residue to the soil helps to maintain the organic matter content and fertility and improves the water intake rate.

If irrigated, this soil is suited to corn; dry, edible beans; sugar beets; small grains; alfalfa; and introduced grasses. Water can be applied by a sprinkler or a gravity system. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue and green manure crops into the soil helps to maintain the organic matter content and fertility. All irrigation systems need to be designed so that the water application rate does not exceed the moderately low intake rate of this soil. A tailwater recovery system can be used to conserve water.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with other crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler and gravity systems. Weeds can be controlled if the appropriate herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plant communities.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate rainfall is the principal hazard affecting seedlings and young trees. Seedlings can survive and grow if competing vegetation is controlled or removed by cultivation between the tree rows or by careful use of the appropriate kind of herbicide. Planting an annual cover crop between the tree rows helps to control soil blowing. Irrigation can provide supplemental moisture during periods of low rainfall.

The use of this soil for septic tank absorption fields is limited by depth to bedrock. This limitation can be overcome by mounding the site with several feet of suitable fill material to improve the filtering capacity of the soil. The moderate permeability of this soil is a limitation affecting septic tank absorption fields, but increasing the size of the absorption field can generally overcome this limitation. This soil is generally suited to sites for dwellings. A good surface drainage system can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIc-1, dryland, and I-4, irrigated; Silty range site; and windbreak suitability group 3.

AcB—Alliance loam, 1 to 3 percent slopes. This deep, very gently sloping, well drained soil is on uplands. It formed in loess and the underlying calcareous sandstone. Areas range from 5 to 750 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 8 inches thick. The subsoil is about 15 inches thick. The upper part is grayish brown, firm silty clay loam; the middle part is pale brown, firm silty clay loam; and the lower part is pale brown, friable loam. The underlying material is light gray, calcareous very fine sandy loam to a depth of 49 inches. Below this to a depth of 60 inches or more is white, calcareous sandstone. In some places the bedrock is at a depth of more than 60 inches. In other places the surface layer is silt loam. In some areas the subsoil is sandy clay loam.

Included with this soil in mapping are small areas of Duroc and Rosebud soils. Duroc soils have a dark surface soil more than 20 inches thick and are in slightly concave areas on the landscape that are lower than the Alliance soil. Rosebud soils are 20 to 40 inches deep over calcareous sandstone and are on convex knolls that are higher on the landscape than the Alliance soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Alliance soil. Available water capacity is high. The organic matter content is moderate. Runoff is slow. The water intake rate is moderately low.

Most of the acreage of this soil is cultivated (fig. 8). About half of the acreage is used for dryland farming, and the rest is used as irrigated cropland. A few areas are used as rangeland.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Soil blowing and water erosion are slight hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to conserve soil moisture and control soil blowing. Cover crops also help to control erosion. Returning crop residue to the soil helps to maintain the organic matter content and fertility and improves the water intake rate.

If irrigated, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. Water can be applied by a sprinkler or a gravity system. Land leveling is generally needed if a gravity system is used so that water movement and intake rate are uniform. Soil blowing and water erosion are slight hazards. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue into the soil helps to maintain the organic matter content and fertility. All irrigation systems need to be designed so that the water application rate does not exceed the moderately low intake rate of this soil. A tailwater recovery system can be used to conserve water.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with other crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler and gravity systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. As a result, water erosion and soil blowing are excessive. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plant communities.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate rainfall and soil erosion are the principal hazards affecting seedlings and young trees. Seedlings can survive and grow if competing vegetation is controlled or removed by cultivation between the tree rows or by careful use of the appropriate kind of herbicide. Planting an annual cover crop between the tree rows helps to control soil blowing. Irrigation can provide supplemental moisture during periods of low rainfall.

The use of this soil for septic tank absorption fields is limited by depth to bedrock. This limitation can be overcome by mounding the site with several feet of suitable fill material to improve the filtering capacity of the soil. The moderate permeability of this soil is a

Figure 8.—Most areas of Alliance loam, 1 to 3 percent slopes, are used as cropland.

limitation affecting septic tank absorption fields, but increasing the size of the absorption field can generally overcome this limitation. On sites for sewage lagoons, some grading is needed to modify the slope and to shape the lagoon. This soil is generally suited to sites for dwellings. A good surface drainage system can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIe-1, dryland, and IIe-4, irrigated; Silty range site; and windbreak suitability group 3.

AcC—Alliance loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on uplands. It formed in loess and the underlying calcareous sandstone. Areas range from 5 to 500 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 9 inches thick. The subsoil is about 14 inches thick. The upper part is grayish brown, firm silty clay loam, and the lower part is pale brown, friable, calcareous silt loam. The underlying material is light gray and calcareous. It is loam in the upper part and very fine sandy loam in the lower part. White, calcareous, fine grained sandstone is below a depth of about 56 inches and extends to a depth of 60 inches or more. In cultivated areas 5 to 20 percent of this soil is eroded. In these areas erosion has removed all or most of the original surface soil, and tillage has mixed the remaining surface layer with the subsurface soil. In most places the surface layer is light in color and calcareous. In other places the surface layer is silty clay loam, silt loam, or fine sandy loam. In some places sandstone is at a depth of more than 60 inches.

Included with this soil in mapping are small areas of Canyon, Duroc, and Rosebud soils. Canyon soils have calcareous sandstone at a depth of 10 to 20 inches. Duroc soils have a dark surface soil more than 20 inches thick and are in concave areas that are lower on the landscape than the Alliance soil. Rosebud soils

are 20 to 40 inches deep over calcareous sandstone and generally are slightly higher on the landscape than the Alliance soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Alliance soil. Available water capacity is high. The organic matter content is moderate. Runoff is medium. The water intake rate is moderately low.

Most of the acreage of this soil is cultivated. About half of the acreage is used for dryland farming, and the rest is used as irrigated cropland. A few areas are used as rangeland.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Water erosion and soil blowing are the principal hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to conserve soil moisture and control serious soil blowing and water erosion. Cover crops also help to control erosion. Returning crop residue to the soil helps to maintain the organic matter content and tilth and improves the water intake rate.

If irrigated by a sprinkler system, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. A sprinkler system is best suited to this soil. Gravity systems need to be leveled to a proper grade so that water movement and intake are uniform. Soil erosion is the principal hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control water erosion and soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue into the soil helps to maintain the organic matter content and fertility. The efficient use of irrigation water is a management concern because the application of excessive amounts of water can result in water erosion on these slopes. All irrigation systems need to be designed so that the water application rate does not exceed the moderately low intake rate of this soil. A tailwater recovery system can be used to conserve water.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with other crops. Such cool-season grasses as pubescent wheatgrass or intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. This soil is subject to water erosion. Continuous heavy grazing causes poor plant vigor and reduced forage production. Continuous heavy grazing and improper haying also reduce the amount of protective cover, resulting in soil blowing and the formation of small gullies and rills after heavy rains. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing and water erosion. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. As a result, water erosion and soil blowing are excessive. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plant communities. Range seeding may be needed to stabilize severely eroded areas of cropland.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate rainfall and soil blowing are the principal hazards affecting seedlings and young trees. Seedlings can survive and grow if competing vegetation is controlled or removed by cultivation between the tree rows or by careful use of the appropriate kind of herbicide. Planting an annual cover crop between the tree rows helps to control soil blowing. Irrigation can provide supplemental moisture during periods of low rainfall.

The use of this soil for septic tank absorption fields is limited by depth to bedrock. This limitation can be overcome by mounding the site with several feet of suitable fill material to improve the filtering capacity of the soil. The moderate permeability of this soil is a limitation affecting septic tank absorption fields, but increasing the size of the absorption field can generally overcome this limitation. Buildings and dwellings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. A good surface drainage system can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIIe-1, dryland, and IIIe-4, irrigated; Silty range site; and windbreak suitability group 3.

An—Almeria loamy fine sand, channeled, 0 to 2 percent slopes. This very deep, very gently sloping, very poorly drained soil is on channeled bottom land generally adjacent and parallel to the Niobrara River (fig. 9). The soil formed in sandy alluvium. It is frequently flooded for brief periods and is occasionally ponded by water from the seasonal high water table. Areas range from 5 to 500 acres in size.

Typically, the surface layer is grayish brown, very friable, calcareous loamy fine sand about 8 inches thick. It has dark yellowish brown mottles. The underlying material is light gray, calcareous sand stratified with loamy very fine sand to a depth of more than 60 inches. The upper part has yellowish brown mottles. In some places the surface layer is fine sandy loam or fine sand. In a few areas the underlying material has thin strata of gravelly coarse sand.

Included with these soils in mapping are small areas of Bolent and Calamus soils, Fluvaquents, and areas of water. Bolent and Calamus soils are better drained than the Almeria soil and are slightly higher on the landscape. Areas of Fluvaquents are lower on the landscape than the Almeria soil and generally have water above the surface most of the year. Included areas make up 10 to 15 percent of the unit.

Permeability is rapid in the Almeria soil. Available water capacity is low. The organic matter content is moderately low. Runoff is very slow. The seasonal high water table ranges from 0.5 foot above the surface during wet years to a depth of 1.0 foot during dry years.

Most of the acreage of this soil is used for range. The rest is covered by trees and shrubs. The dominant vegetation is American licorice, cottonwood, and willow. The soil provides good habitat for wildlife.

This soil is not suited to farming because of the wetness and the hazard of frequent flooding.

If this soil is used as range or hayland, the climax vegetation is dominantly prairie cordgrass, bluejoint reedgrass, northern reedgrass, and sedges. These species make up 65 percent or more of the total annual forage. Bluegrass, slender wheatgrass, green muhly, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, prairie cordgrass, bluejoint reedgrass, and northern reedgrass decrease in abundance and are replaced by slender wheatgrass, bluegrass, green muhly, sedges, rushes, and forbs. If overgrazing or improper haying continues for many years, bluegrass, foxtail barley, sedges, rushes, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 2.0 animal unit months per acre. This soil produces a high quantity of low-quality forage. A planned grazing system that includes proper grazing use, timely deferments from grazing and haying, and restricted use during very wet periods helps to maintain or improve the range condition. During wet periods, grazing and operating heavy machinery can cause surface compaction and the formation of mounds and ruts, which make grazing or harvesting hay difficult.

If this soil is used as hayland, mowing should be regulated so that the grasses remain healthy and vigorous. In wet years, some areas of hay cannot be harvested. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in the spring before the ground thaws.

This soil is not suited to the trees and shrubs planted in windbreaks because of the wetness caused by the high water table and the hazard of frequent flooding. A few marginal areas may be suitable for the trees and shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

These soils are not suited to septic tank absorption fields, dwellings, or buildings because of the flooding and the seasonal high water table. A suitable alternative site should be selected. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving if the shoring takes place during dry periods. Constructing roads on suitable, well compacted fill material, providing adequate side ditches, and installing culverts help protect roads from the damage caused by floodwater and the wetness caused by the seasonal high water table. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

The land capability unit is VIw-7, dryland; Wetland range site; and windbreak suitability group 10.

Bc—Bankard loamy fine sand, channeled, 0 to 2 percent slopes. This very deep, somewhat excessively drained soil is on bottom land. It is subject to frequent flooding. The soil formed in sandy alluvium. Areas range from 5 to 75 acres in size.

Typically, the surface layer is grayish brown, very friable loamy fine sand about 7 inches thick. The underlying material is calcareous and extends to a depth of more than 60 inches. The upper part is light brownish gray, stratified fine sand, and the lower part

Figure 9.—A typical area of Almeria loamy fine sand, channeled, 0 to 2 percent slopes, adjacent to the Niobrara River. This soil is frequently flooded.

is light gray, stratified loamy very fine sand. In some places the surface layer is loam, fine sandy loam, or fine sand.

Included with this soil in mapping are small areas of Munjor soils and areas of rock outcrop. Also included are areas along the drainageways that have very steep side slopes. Munjor soils are well drained and have less sand and more clay in the profile than the Bankard soil. These soils are on similar landscapes. The areas of rock outcrop are higher on the landscape than the Bankard soil. They are on breaks along the channel. Included areas make up 10 to 20 percent of the unit.

Permeability is rapid in the Bankard soil, and available water capacity is low. The organic matter content is moderately low. Runoff is slow. The water intake rate is very high.

Most areas of this soil are used as range or hayland. A few areas are covered by trees and shrubs. The dominant vegetation is cottonwood, green ash, and buckbrush.

This soil is not suited to cropland because of the hazard of frequent flooding.

If this soil is used as range or hayland, the climax vegetation is dominantly sand bluestem, prairie sandreed, needleandthread, and switchgrass. These species make up 45 percent or more of the total annual forage. Blue grama, prairie junegrass, bluegrass, indiangrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, indiangrass, little bluestem, and switchgrass decrease in abundance and are replaced by prairie sandreed, needleandthread, sand dropseed, blue grama, sedges, and forbs. If overgrazing continues for many years, blue grama, sand dropseed, needleandthread, Scribner panicum, sedges, and forbs dominate the site. Under these conditions, the native plants lose vigor and are unable to stabilize the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing

use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, mowing should be regulated so that the grasses remain healthy and vigorous. The forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range.

This soil generally is not suited to the trees and shrubs planted in windbreaks. A few areas can be used for the trees and shrubs that enhance recreational areas or wildlife habitat if they are planted by hand or if other special management is used.

This soil is not suited to use as sites for sanitary facilities or buildings because of the frequent flooding. An alternative site should be selected. The sides of shallow excavations can cave in unless they are shored. If areas of this soil are used for roads, bridges or culverts are needed. Constructing roads on suitable, well compacted material above the flood level and providing adequate side ditches help to prevent the damage caused by floodwater.

The land capability unit is VIw-5, dryland; Sandy Lowland range site; and windbreak suitability group 10.

Bd—Beckton silt loam, 0 to 2 percent slopes. This very deep, nearly level, moderately well drained soil is on alluvial fans and low stream terraces. This soil formed in loamy alluvium. It is subject to rare flooding. Areas range from 10 to 1,200 acres in size.

Typically, the surface layer is dark grayish brown, very friable silt loam about 5 inches thick. The subsurface layer is light gray, very friable silt loam about 3 inches thick. The subsoil is about 27 inches thick. It is grayish brown, firm silty clay loam in the upper part and brown, firm, calcareous silt loam in the lower part. The underlying material is light gray, calcareous silt loam to a depth of 60 inches or more. This soil has a high content of sodium. In some places the surface layer is fine sandy loam or loamy fine sand. In some areas the dark surface layer is less than 7 inches thick. In other areas the subsoil is sandy clay loam or loam.

Included with this soil are small areas of Lute and McCook soils. Lute soils are somewhat poorly drained and are lower on the landscape than the Beckton soil. McCook soils are not sodium-affected and are well drained. These soils are slightly higher on the landscape than the Beckton soil. Included soils make up 5 to 15 percent of the unit.

Permeability is slow in the Beckton soil. Available water capacity is moderate. Runoff is slow, and water may stand in microdepressions on the surface for short periods. Organic matter content is moderately low. This soil contains sodium and other salts that are detrimental to crops. The water intake rate is moderate. The seasonal high water table ranges from a depth of about 4 feet during wet years to about 6 feet during dry years.

Most of the acreage of this soil supports native grasses and is used as rangeland or hayland. The rest is used for irrigated crops.

If dryland farmed, this soil is poorly suited to small grains, alfalfa, and introduced grasses. The sodium in the subsoil is toxic to some plants. This soil is flooded for very brief periods, and damage to crops is seldom severe. Soil blowing is also a serious hazard on unprotected surfaces. A system of conservation tillage, such as stubble mulching and ecofallow, helps to control soil blowing and conserve soil moisture. This soil is droughty in summer. The first cutting of alfalfa is the most suitable crop because it grows and matures in the spring when the amount of rainfall is plentiful. Stripcropping helps to control soil blowing. Summer fallowing conserves moisture for use during the following growing season.

If irrigated by a sprinkler system, this soil is poorly suited to small grains, alfalfa, and introduced grasses. The sodic condition of the soil limits crop production because sodium is toxic to some plants. This soil is flooded for very brief periods, and damage to crops is seldom severe. A system of conservation tillage, such as no-till or ecofallow, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture.

If this soil is used as range or hayland, the climax vegetation is dominated by alkali sacaton, inland saltgrass, blue grama, and western wheatgrass. These species make up 60 percent or more of the total annual forage. Buffalograss, bluegrass, slender wheatgrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, alkali sacaton, western wheatgrass, and slender wheatgrass decrease in abundance and are replaced by inland saltgrass, blue grama, buffalograss, bluegrass, and sedges.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain and improve the range condition. Properly located fences and livestock watering and

salting facilities can result in a more uniform distribution of grazing. The alkalinity of the soil varies, which results in irregular patterns of short and tall grasses. Short grasses are dominant in areas where the alkalinity is high.

If this soil is used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy.

This soil is poorly suited to the trees and shrubs planted in windbreaks because of the high content of sodium. The sodic condition of the soil limits the species that can be grown. Only species that are tolerant of a high content of sodium should be selected. The weeds and undesirable grasses can be controlled by cultivation between the tree rows with conventional equipment. Areas in the rows that are close to the trees can be hoed by hand or rototilled, or an appropriate kind of herbicide can be used to control the competing vegetation. Irrigation can provide supplemental moisture during periods of low rainfall.

Constructing septic tank absorption fields on fill material raises the fields a sufficient distance above the seasonal high water table. The slow permeability of the subsoil is a limitation affecting septic tank absorption fields, but increasing the size of the absorption field can generally overcome this limitation. Strengthening the foundations of dwellings and buildings and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling, and constructing roads on raised, well compacted fill material helps to prevent the damage caused by floodwater. Mixing the base material for roads and streets with additives, such as hydrated lime, can help to prevent shrinking and swelling. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate side ditches, and installing culverts help to prevent the damage to roads caused by floodwater.

The land capability units are IVs-1, dryland, and IVs-5, irrigated; Saline Lowland range site; and windbreak suitability group 9S.

Bf—Bolent loamy fine sand, 0 to 2 percent slopes. This very deep, nearly level, somewhat poorly drained soil is on bottom land along the Niobrara River and other major drainageways. The soil formed in sandy alluvium. It is occasionally flooded for brief periods. Areas of this soil are commonly long and narrow and range from 15 to 400 acres in size.

Typically, the surface layer is light brownish gray, very friable, calcareous loamy fine sand about 7 inches thick. The underlying material extends to a depth of 60 inches or more. The upper part is light gray, calcareous fine sand stratified with grayish brown loamy fine sand; the middle part is stratified white and light gray, mottled, calcareous fine sand; the next part is white fine sand stratified with light gray loamy very fine sand; and the lower part is white fine sand. In some places the surface layer is very fine sandy loam, fine sandy loam, or fine sand.

Included with this soil in mapping are small areas of Almeria, Calamus, and Las Animas soils. Almeria soils are lower on the landscape than the Bolent soil and are very poorly drained. Calamus soils are higher on the landscape than the Bolent soil and are moderately well drained. Las Animas soils are less sandy in the profile than the Bolent soil and are on similar landscapes. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Bolent soil, and available water capacity is low. The organic matter content is low. Runoff is very slow. The water intake rate is very high. This soil has a seasonal high water table that ranges from a depth of 1.5 feet during wet years to 3.0 feet during dry years.

Most areas of this soil are used as range or hayland. A few areas along the Niobrara River are covered by trees and shrubs. The dominant vegetation is cottonwood, willow, and buckbrush.

If dryland farmed, this soil is poorly suited to the crops commonly grown in the county. Flooding and the wetness caused by the seasonal high water table are hazards. The low available water capacity is a severe limitation during dry periods.

If irrigated by a sprinkler system, this soil is poorly suited to corn, small grains, alfalfa, and introduced grasses. This soil is not suited to a gravity system because of the very high water intake rate and rapid permeability. This soil is flooded for brief periods, but the damage to crops caused by flooding is seldom severe. The main limitation is the wetness caused by the high water table. Soil blowing is also a hazard on unprotected surfaces. This soil dries out slowly in the spring, and tillage and planting are delayed because of the wetness. A system of conservation tillage, such as no-till, keeps crop residue on the surface and helps to control soil blowing and conserve moisture. Cover crops also help to control erosion. Returning crop residue to the soil helps improve the organic matter content and fertility. Supplemental applications of nitrogen and phosphorus are needed for maximum crop production. The efficient use of irrigation water is a management concern because excessive amounts

of water leach plant nutrients. This soil needs frequent applications of irrigation water because of the low available water capacity.

If this soil is used as range or hayland, the climax vegetation is dominantly big bluestem, little bluestem, indiangrass, switchgrass, and sedges. These species make up 75 percent or more of the total annual forage. Prairie cordgrass, bluegrass, and forbs dominate the rest. If subject to continuous heavy grazing or improperly harvested for hay, big bluestem, little bluestem, indiangrass, switchgrass, and prairie cordgrass decrease in abundance and are replaced by western wheatgrass, bluegrass, slender wheatgrass, green muhly, sedges, and rushes. If overgrazing or improper haying continues for many years, bluegrass, sedges, rushes, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 1.6 animal unit months per acre. A planned grazing system that includes proper grazing use, timely deferments from grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. Areas of this soil are generally the first to be overgrazed in a pasture that includes the better drained, sandy soils. Properly located fences and livestock watering and salting facilities result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. The hay is of best quality when the grasses are cut early. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in the spring before the ground thaws.

This soil is suited to the trees and shrubs planted in windbreaks. The species selected for planting should be those that withstand the occasional wetness. The main limitation affecting the establishment of windbreaks is the wetness caused by the high water table. Tilling and planting seedlings should be delayed until after the soil has begun to dry. The weeds and undesirable grasses can be controlled by cultivation between the tree rows with conventional equipment and by the use of the appropriate kind of herbicide in the rows. Care is also needed during the establishment of windbreaks to prevent soil blowing during dry periods.

The hazard of occasional flooding needs to be considered if this soil is used for sanitary facilities and building sites. Constructing septic tank absorption fields on fill material raises the fields a sufficient distance above the seasonal high water table. This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. Constructing dwellings and buildings on raised, well compacted fill material helps to prevent the damage caused by floodwater and helps to overcome the wetness caused by the high water table. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate side ditches, and installing culverts help protect roads from the damage caused by floodwater and the wetness caused by the seasonal high water table. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving if the shoring takes place during dry periods.

The land capability units are IVw-5, dryland, and IVw-11, irrigated; Subirrigated range site; and windbreak suitability group 2S.

Bh—Bridget very fine sandy loam, 0 to 1 percent slopes. This very deep, nearly level, well drained soil is on foot slopes, stream terraces, and alluvial fans. The soil formed in loamy colluvial and alluvial sediments. Areas range from 5 to 500 acres in size.

Typically, the surface layer is grayish brown, very friable very fine sandy loam about 8 inches thick. The subsurface layer is dark grayish brown, very friable very fine sandy loam about 7 inches thick. The transitional layer is pale brown, very friable, calcareous very fine sandy loam about 6 inches thick. The underlying material is calcareous very fine sandy loam to a depth of more than 60 inches. The upper part is pale brown, and the lower part is light brownish gray. In some places the surface layer is loam. In other places carbonates are below a depth of 15 inches.

Included with these soils in mapping are small areas of Ponderosa and Thirtynine soils. Ponderosa soils contain more sand than the Bridget soil and are higher on the landscape. Thirtynine soils have more clay than the Bridget soil and are higher on the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Bridget soil, and available water capacity is high. Organic matter content is moderate. Runoff is very slow. The water intake rate is moderate.

Most of the acreage of this soil is used for farming. A few small areas are irrigated. The rest is used as rangeland.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can

be successfully grown. Soil blowing is a hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to conserve soil moisture and control soil blowing. Cover crops also help to control soil blowing. Returning crop residue to the soil helps improve the organic matter content and the water intake rate.

If irrigated, this soil is suited to corn, field beans, small grains, alfalfa, and introduced grasses. Water can be applied by sprinkler or gravity systems. For gravity irrigation systems, some land leveling generally is needed so that water movement and intake rate are uniform. Soil blowing is a hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue and green manure crops into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water leach plant nutrients below the root zone.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with other crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler or gravity systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. As a result, soil blowing is excessive. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help keep the native plants in good condition.

If this soil is used as range, the natural plant community is mostly short and mid grasses and some tall grasses. Blue grama, needleandthread, sideoats grama, and western wheatgrass are dominant. If overgrazed, the mid and tall grasses lose vigor and blue grama, buffalograss, western wheatgrass, pricklypear, and other annual and perennial weeds become the dominant species.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate rainfall and soil blowing are the principal hazards affecting seedlings and young trees. Seedlings can survive and grow if competing vegetation is controlled or removed by cultivation between the tree rows or by careful use of the appropriate kind of herbicide. Planting an annual cover crop between the tree rows helps to control soil blowing. Irrigation can provide supplemental moisture during periods of low rainfall.

This soil is generally suited to use as building sites. The moderate permeability is a limitation on sites for septic tank absorption fields. Increasing the size of the absorption field can generally overcome this limitation. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The land capability units are IIc-1, dryland, and IIe-6, irrigated; Silty range site; and windbreak suitability group 3.

BhB—Bridget very fine sandy loam, 1 to 3 percent slopes. This very deep, very gently sloping, well drained soil is on foot slopes, stream terraces, and alluvial fans. The soil formed in loamy colluvial and alluvial sediments. Areas range from 5 to more than 500 acres in size.

Typically, the surface layer is dark grayish brown, very friable very fine sandy loam about 7 inches thick. The subsurface layer is about 7 inches thick. It is similar to the surface layer in color and texture. The transitional layer is pale brown, very friable, calcareous very fine sandy loam about 5 inches thick. The underlying material to a depth of more than 60 inches is pale brown, very friable, calcareous very fine sandy loam. In some places the surface layer is loam. In other places carbonates are below a depth of 15 inches.

Included with this soil in mapping are small areas of Ponderosa and Thirtynine soils. Ponderosa soils contain more sand than the Bridget soil and are higher on the landscape. Thirtynine soils have more clay than the Bridget soil and are higher on the landscape. Included soils make up 5 to 15 percent of the map unit.

Permeability is moderate in the Bridget soil. Available water capacity is high. Organic matter

content is moderate. Runoff is slow. The water intake rate is moderate.

Most of the acreage of this soil is used for dryland farming. A few small areas are irrigated. The rest is mainly used as rangeland.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Water erosion and soil blowing are the principal hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to conserve soil moisture and control water erosion and soil blowing. Cover crops also help to control erosion. Returning crop residue to the soil helps improve the organic matter content and the water intake rate.

If irrigated, this soil is suited to corn, field beans, small grains, alfalfa, and introduced grasses. Water can be applied by sprinkler or gravity systems. For gravity irrigation systems, some land leveling is needed so that water movement and intake are uniform. Water erosion and soil blowing are the principal hazards. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue and green manure crops into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water leach plant nutrients below the root zone.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with other crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. This soil is subject to water erosion. Continuous heavy grazing and improper haying also reduce the amount of protective cover and can result in soil blowing and the formation of small gullies and rills after heavy rains. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing and water erosion. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. As a result, water erosion and soil blowing are excessive. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help keep the native plants in good condition. Range seeding may be needed to stabilize severely eroded areas of cropland.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate rainfall and erosion are the principal hazards affecting seedlings and young trees. Seedlings can survive and grow if competing vegetation is controlled or removed by cultivation between the tree rows or by careful use of the appropriate kind of herbicide. Planting an annual cover crop between the tree rows helps to control water erosion and soil blowing. Irrigation can provide supplemental moisture during periods of low rainfall.

This soil is generally suited to use as building sites. The moderate permeability is a limitation on sites for septic tank absorption fields. Increasing the size of the absorption field can generally overcome this limitation. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The land capability units are IIe-3, dryland, and IIe-6, irrigated; Silty range site; and windbreak suitability group 3.

Bm—Bridget loam, 0 to 1 percent slopes. This very deep, nearly level, well drained soil is on foot slopes, stream terraces, and alluvial fans. The soil formed in loamy alluvial sediment. Areas range from 20 to 1,000 acres in size.

Typically, the surface layer is grayish brown, very friable loam about 6 inches thick. The subsurface layer is about 3 inches thick. It is similar to the surface layer in color and texture. The transitional layer is light brownish gray, very friable, calcareous loam about 6 inches thick. The underlying material to a depth of more than 60 inches is light gray, calcareous loam. In some places the surface layer is silt loam or very fine sandy loam. In other places carbonates are below a depth of 15 inches.

Included with this soil in mapping are small areas of Duroc, McCook, and Thirtynine soils. Duroc soils have a dark surface soil more than 20 inches thick and are in swales. They are lower on the landscape than the

Bridget soil. McCook soils are stratified and are lower on the landscape than the Bridget soil. Thirtynine soils have more clay than the Bridget soil and are higher on the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Bridget soil, and available water capacity is high. The organic matter content is moderate. Runoff is very slow. The water intake rate is moderate.

Most of the acreage of this soil is cultivated. Nearly all of the cultivated areas are used for dryland farming. A few small areas are irrigated. The rest are used as rangeland.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Soil blowing is a slight hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to conserve soil moisture and control soil blowing. Cover crops also help to control erosion. Returning crop residue to the soil helps improve the organic matter content and the water intake rate.

If irrigated, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. Water can be applied by sprinkler or gravity systems. For gravity irrigation systems, some land leveling generally is needed. Soil blowing is a slight hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue and green manure crops into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water leach plant nutrients below the root zone.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with other crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. As a result, water erosion and soil blowing are excessive. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help keep the native plants in good condition.

If this soil is used as range, the natural plant community is dominated by blue grama, needleandthread, sideoats grama, and western wheatgrass. If overgrazed, the mid and tall grasses lose vigor and blue grama, buffalograss, western wheatgrass, pricklypear, and other annual and perennial weeds become the dominant species.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate rainfall is the principal hazard affecting seedlings and young trees. Seedlings can survive and grow if competing vegetation is controlled or removed by cultivation between the tree rows or by careful use of the appropriate kind of herbicide. Planting an annual cover crop between the tree rows helps to control soil blowing. Irrigation can provide supplemental moisture during periods of low rainfall.

This soil is generally suited to use as building sites. The moderate permeability is a limitation on sites for septic tank absorption fields. Increasing the size of the absorption field can generally overcome this limitation. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The land capability units are IIc-1, dryland, and I-6, irrigated; Silty range site; and windbreak suitability group 3.

BnB—Bufton silty clay loam, 1 to 3 percent slopes. This very deep, very gently sloping, well drained soil is on uplands, foot slopes, and stream terraces. The soil formed in material weathered from silty shale or colluvial and alluvial sediments weathered from shale. Areas range from 10 to 200 acres in size.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 6 inches thick. The subsoil is about 22 inches thick. It is grayish brown,

firm, calcareous silty clay in the upper part; light brownish gray, firm, calcareous silty clay in the middle part; and light gray, friable, calcareous silty clay loam in the lower part. The underlying material is white, calcareous silty clay loam to a depth of more than 60 inches. In some places the surface layer is silt loam or clay loam. In other places shale is at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of Orella and Thirtynine soils. Orella soils are shallow and are on ridgetops and knolls. Thirtynine soils have a thicker dark surface layer than the Bufton soil and are higher on the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Bufton soil. Available water capacity is high. Runoff is slow. The organic matter content is moderately low. Chalcedony fragments are scattered on the surface of the soil and throughout the profile.

Most of the acreage of this soil is used for range. The rest is used mainly for dryland crops or for hay and pasture.

If dryland farmed, this soil is suited to wheat, alfalfa, and oats. Water erosion and the lack of seasonal rainfall are the main hazards. A system of conservation tillage, such as ecofallow or discing, that leaves all or part of the crop residue on the surface helps to conserve soil moisture and control erosion. Terraces and contour farming help to control water erosion.

If irrigated, this soil is suited to alfalfa, small grains, and introduced grasses. Water can be applied by sprinkler or gravity systems. Land leveling is needed for gravity irrigation. A system of conservation tillage that keeps crop residue on the surface helps to control erosion and conserve soil moisture.

If this soil is used as range, the climax vegetation is dominated by little bluestem, sideoats grama, blue grama, western wheatgrass, needleandthread, and threadleaf sedge. These species make up 70 percent or more of the total annual production. Buffalograss, green needlegrass, prairie sandreed, and other annual and perennial grasses, forbs, and shrubs make up the remaining 30 percent. If subject to continuous heavy grazing, little bluestem and western wheatgrass decrease in abundance. Initially, these species are replaced by blue grama, hairy grama, prairie sandreed, sand dropseed, needleandthread, plains muhly, Sandberg bluegrass, sedges, annual grasses, and forbs. If overgrazing continues for many years, the native grasses lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.6 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The areas away from the watering facilities may be underused. Properly locating fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time salt is provided help to prevent excessive trampling and local overuse. Proper grazing use is very effective in controlling soil erosion. Areas previously used as cropland should be reseeded to a suitable grass mixture.

If this soil is used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be only used as fall or winter range. The production of hay can be increased by using contour ditches to spread irrigation water on this soil. Timely application and efficient distribution of water may be difficult because of the uneven slopes.

This soil is suited to introduced grasses or legumes used as pasture or hayland. These grasses can be rotated with other crops. Such cool-season grasses as crested wheatgrass, intermediate wheatgrass, and western wheatgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or clover. This soil is subject to water erosion. Continuous heavy grazing causes poor plant vigor and results in the formation of rills after heavy rains. Rotation grazing and proper stocking rates help keep the grasses in good condition. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is poorly suited to the trees and shrubs planted in windbreaks. The high content of clay, water erosion, and droughtiness are limitations. The soil should be prepared for planting when it is moist but not wet. Sites may be prepared by tillage or a combination of chemicals and tillage. A drip irrigation system can provide supplemental moisture during periods of low rainfall. Planting the trees on the contour helps to control water erosion. The undesirable weeds and grasses can be controlled by cultivation with conventional equipment between the tree rows. The appropriate kind of herbicide can be applied in areas in the rows. Areas can be hoed by hand or rototilled.

Because of the moderately slow permeability, this soil is poorly suited to septic tank absorption fields. Enlarging the absorption field or installing an alternative system helps to ensure that the absorption field functions properly. Strengthening the foundations

of buildings and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. Mixing the base material for roads and streets with additives, such as hydrated lime, can help to prevent shrinking and swelling. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The land capability units are IIIe-1, dryland, and IIIe-3, irrigated; Clayey range site; and windbreak suitability group 4L.

BnE—Bufton silty clay loam, 9 to 20 percent slopes. This very deep, moderately steep, well drained soil is on uplands. This soil formed in material weathered from silty shale. Areas range from 5 to 200 acres in size.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 4 inches thick. The subsoil is firm, calcareous silty clay loam about 20 inches thick. The upper part is brown, and the lower part is light gray. The underlying material to a depth of more than 60 inches is light gray, calcareous silt loam. In some places the surface layer is silt loam, clay loam, or silty clay. In other places lime is leached to a depth of 6 inches or more. In some areas shale is at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of Enning, Minnequa, and Orella soils. The included soils are on similar landscapes as the Bufton soil. Enning and Orella soils are shallow. Minnequa soils are moderately deep. Enning and Minnequa soils formed in material weathered from interbedded chalk and shale. Orella soils formed in material weathered from shale. Included soils make up 5 to 25 percent of the unit.

Permeability is moderately slow in the Bufton soil. Available water capacity is high. Runoff is rapid. Organic matter content is moderately low.

All of the acreage of this soil is used as rangeland. This soil is not suited to cropland because of the steep slopes.

If this soil is used as range, the climax vegetation is dominated by little bluestem, sideoats grama, western wheatgrass, blue grama, needleandthread, and threadleaf sedge. These species make up 70 percent or more of the total annual production. Buffalograss, green needlegrass, prairie sandreed, and other annual and perennial grasses, forbs, and shrubs make up the remaining 30 percent. If subject to continuous heavy grazing, little bluestem and western wheatgrass decrease in abundance. Initially, these species are replaced by blue grama, hairy grama, prairie sandreed, sand dropseed, needleandthread, plains muhly, Sandberg bluegrass, sedges, annual grasses, and forbs. If overgrazing continues for many years, the native grasses lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.6 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The areas away from the watering facilities may be underused. Properly locating fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time salt is provided help to prevent excessive trampling and local overuse.

Proper grazing use is very effective in controlling soil erosion. Areas previously used as cropland should be reseeded to a suitable grass mixture. In areas where gullies have formed because of severe water erosion, land shaping or mechanical practices may be required in addition to deferment to stabilize the area.

If this soil is used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be only used as fall or winter range.

This soil is poorly suited to the trees and shrubs planted in windbreaks. The soil should be prepared for planting when it is moist but not wet. Sites may be prepared by tillage or a combination of chemicals and tillage. Irrigation can provide supplemental moisture during periods of low rainfall. The undesirable weeds and grasses can be controlled by cultivation with conventional equipment. Annual cover crops can be planted between the tree rows. The appropriate kind of herbicide can be used in areas in the rows. Some areas can be hoed by hand or rototilled. Planting the trees on the contour helps to conserve moisture and prevent excessive runoff and erosion. Light cultivation and supplemental watering closes the cracks caused by shrinking and swelling and thus helps protect the roots from exposure.

Because of the moderately slow permeability and the slope, this soil is poorly suited to septic tank absorption fields. In areas where the slope is less than 15 percent, enlarging the absorption field, land shaping, and installing the field on the contour helps to ensure that the absorption field functions properly. In areas where the slope is more than 15 percent, the soil is generally not suited to sanitary facilities. A

suitable alternative site should be selected. Strengthening the foundations of buildings and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. Dwellings and buildings also need to be properly designed so that they conform to the natural slope of the land, or the soil can be graded to a suitable gradient. Mixing the base material for roads and streets with additives, such as hydrated lime, can help to prevent shrinking and swelling. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance. Cutting and filling generally can provide a suitable grade for roads and streets.

The land capability unit is VIe-1, dryland; Clayey range site; and windbreak suitability group 4L.

BoD—Bufton-Orella complex, 3 to 9 percent slopes. These gently sloping and strongly sloping, well drained soils are on uplands. The Bufton soil is very deep, and the Orella soil is shallow. They formed in material weathered from shale. The Bufton soil is on the lower side slopes and broad ridgetops. The Orella soil is on shoulders and on narrow ridgetops and knolls. Areas range from 20 to 200 acres in size. They consist of 60 to 80 percent Bufton soil and 20 to 40 percent Orella soil. These soils are so intermingled or mixed that separating them in mapping is not practical.

Typically, the Bufton soil has a surface layer of grayish brown, friable silty clay loam about 5 inches thick. The subsoil is about 18 inches thick. It is light brownish gray and light gray, firm, calcareous silty clay in the upper part and light gray, firm, calcareous silty clay loam in the lower part. The underlying material to a depth of more than 60 inches is light gray silty clay loam. In some places the surface layer is silt loam or clay loam. In other places shale is at a depth of 40 to 60 inches.

Typically, the Orella soil has a surface layer of grayish brown, firm silty clay loam about 5 inches thick. The transitional layer is light brownish gray, firm, calcareous silty clay loam about 5 inches thick. The underlying material is light gray, calcareous silty clay loam to a depth of 16 inches. Below this to a depth of more than 60 inches is white, silty shale. The Orella soil has a high content of sodium. In some places the surface layer is clay loam or silty clay.

Included with these soils in mapping are small areas of Epping and Thirtynine soils, which formed in material weathered from siltstone. The included soils have less clay than the Bufton and Orella soils. Thirtynine soils have a thicker dark surface layer than the Bufton and Orella soils. Included soils make up 10 to 15 percent of the unit.

Permeability is moderately slow in the Bufton soil and very slow in the Orella soil. Available water capacity is high in the Bufton soil and very low in the Orella soil. The organic matter content is moderately low in the Bufton soil and low in the Orella soil. Runoff is medium.

Nearly all of the acreage of these soils support native grasses and are used as range. A few small areas are used as dry-farmed cropland.

If dryland farmed, the Bufton soil is poorly suited to wheat, alfalfa, and oats. Water erosion is the main hazard. A system of conservation tillage that leaves crop residue on the surface helps to conserve soil moisture and control erosion. The shallow depth to bedrock in the Orella soil makes terracing these soils difficult.

If irrigated by a sprinkler system, the Bufton soil is suited to small grains, alfalfa, and introduced grasses. It is too steep for gravity irrigation. Management is similar to that used if this soil is dryland farmed.

The Orella soil is too shallow and droughty for use as cropland.

If the Bufton soil is used as range or hayland, the climax vegetation is dominantly little bluestem, western wheatgrass, sideoats grama, blue grama, needleandthread, and threadleaf sedge. These species make up 70 percent or more of the total annual forage. Buffalograss, green needlegrass, prairie sandreed, and forbs make up the rest. The climax vegetation on the Orella soil is dominantly buffalograss, western wheatgrass, and blue grama. These species make up 60 percent or more of the total annual forage. Sideoats grama, alkali sacaton, grasslike plants, and forbs make up the rest. If subject to continuous heavy grazing, western wheatgrass and little bluestem decrease in abundance on the Bufton soil and western wheatgrass and alkali sacaton decrease in abundance on the Orella soil. They are replaced by blue grama, buffalograss, needleandthread, plains muhly, threadleaf sedge, and forbs on the Bufton soil and inland saltgrass, blue grama, hairy grama, threadleaf sedge, and forbs on the Orella soil. If overgrazing continues for many years, the native grasses lose vigor and are unable to stabilize the site. As a result, water erosion is excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.6 animal unit month per acre on the Bufton soil and 0.2 animal unit month per acre on the Orella soil. The stocking rate is determined by the percentage of each soil in the pasture. The range should be closely monitored during use and the

stocking rates adjusted so that one soil does not become overgrazed.

A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. The slope can hinder the movement of livestock. Brush management may be needed in some areas to control the woody plants that invade the site. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range. In some areas other mechanical practices may be needed to smooth and stabilize the site before it is reseeded.

If these soils are used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range.

The Bufton soil is poorly suited to the trees and shrubs planted in windbreaks. The lack of adequate rainfall and the high content of clay are the principal hazards affecting seedlings and young trees. Seedlings can survive and grow if competing vegetation is controlled or removed by cultivation between the tree rows or by careful use of the appropriate kind of herbicide. Planting an annual cover crop between the tree rows helps to control soil blowing. Irrigation can provide supplemental moisture during periods of low rainfall. The Orella soil is generally not suited to the trees and shrubs planted in windbreaks because of the shallow depth to bedrock and the very low available water capacity. Onsite investigation is needed to identify the areas best suited to windbreaks.

In areas of the Bufton soil, the moderately slow permeability is a limitation affecting septic tank absorption fields, but increasing the size of the absorption field generally can overcome this limitation. Land shaping and installing the absorption field on the contour are generally necessary for its proper operation. Sanitary facilities are generally not suited to the Orella soil because of the shallow depth to shale. A suitable alternative site should be selected. The Bufton and Orella soils are poorly suited to building sites. Strengthening the foundations of buildings and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. In areas of the Orella soil, the soft bedrock can be excavated during the construction of dwellings with basements or buildings that have deep foundations. Mixing the base material with additives, such as hydrated lime, minimizes the damage to roads caused by shrinking and swelling. Roads built on this soil should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance. Onsite investigation is needed before any engineering practices are applied.

The land capability units are IVe-1, dryland, and IVe-3, irrigated, for the Bufton soil and VIs-4, dryland, for the Orella soil. The Bufton soil is in the Clayey range site and windbreak suitability group 4L. The Orella soil is in the Saline Upland range site and windbreak suitability group 10.

BsB—Busher fine sandy loam, 0 to 3 percent slopes. This deep, nearly level and very gently sloping, well drained soil is on uplands. The soil formed in material weathered from calcareous sandstone. Areas range from 5 to 225 acres in size.

Typically, the surface layer is dark grayish brown, friable fine sandy loam about 7 inches thick. The subsurface layer is dark grayish brown, friable fine sandy loam about 7 inches thick. The subsoil is friable fine sandy loam about 16 inches thick. It is grayish brown in the upper part and light brownish gray and calcareous in the lower part. The underlying material to a depth of 45 inches is light gray, calcareous fine sandy loam. Below this to a depth of more than 60 inches is white, calcareous sandstone. In some places the dark surface layer is less than 7 inches thick. In other places the surface layer is loamy very fine sand or very fine sandy loam.

Included with this soil in mapping are small areas of Jayem, Tassel, and Vetal soils. Jayem soils do not have sandstone within a depth of 60 inches and are on similar landscapes as the Busher soil. Tassel soils have calcareous sandstone at a depth of 6 to 20 inches and are on convex knolls that are higher on the landscape than the Busher soil. Vetal soils have a dark surface soil thicker than 20 inches and do not have sandstone within a depth of 60 inches. These soils are lower on the landscape than the Busher soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Busher soil, and available water capacity is moderate. The organic matter content is moderately low. Runoff is slow. The water intake rate is moderately high.

Most of the acreage of this soil is farmed. The rest is used for range. The cultivated areas are either dryland farmed or irrigated.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Soil blowing is the principal hazard in areas where the surface is not adequately

protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, help to prevent soil blowing. Because of the moderate available water capacity, these tillage practices also help to conserve soil moisture. Cover crops also help to control erosion. Returning crop residue to the soil helps improve the organic matter content and the water intake rate.

If irrigated, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. This soil is best suited to sprinkler irrigation because of the moderately high water intake rate. Some land leveling is generally needed if gravity systems are used so that water movement and intake rate are uniform. Soil blowing is the principal hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue and green manure crops into the soil helps improve the organic matter content, fertility, and tilth. The efficient use of irrigation water is a management concern because excessive amounts of water leach plant nutrients below the root zone.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, or legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. This soil is subject to water erosion. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Continuous heavy grazing and improper haying also reduce the amount of protective cover and can result in soil blowing and the formation of small gullies and rills after heavy rains. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing and water erosion. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. As a result, soil blowing is excessive and small blowouts can form. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants. Range seeding may be needed to stabilize severely eroded areas of cropland.

This soil is suited to the trees and shrubs planted in windbreaks. Soil blowing is the main hazard affecting the establishment of windbreaks. It can be controlled by maintaining strips of sod or a cover crop between the tree rows. The weeds and undesirable grasses in the tree rows can be controlled by the careful use of the appropriate kind of herbicide or hoeing by hand. Cultivation between the rows with conventional equipment can control undesirable grasses and weeds in areas where strips of sod and cover crops are not used. The lack of adequate rainfall in summer is also a hazard affecting the survival of young trees. Irrigation can provide supplemental moisture during periods of low rainfall.

The use of this soil for septic tank absorption fields is limited by depth to bedrock. Mounding the sites for absorption fields on several feet of suitable fill material improves the filtering capacity of the soil. The sides of shallow excavations can cave in unless they are shored. This soil is generally suited to building sites and roads.

The land capability units are IIIe-3, dryland, and IIe-8, irrigated; Sandy range site; and windbreak suitability group 5.

BsC—Busher fine sandy loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on uplands. The soil formed in material weathered from calcareous sandstone. Areas range from 5 to 130 acres in size.

Typically, the surface layer is grayish brown, friable fine sandy loam about 4 inches thick. The subsurface layer is brown, friable fine sandy loam about 7 inches thick. The subsoil is pale brown, friable fine sandy loam about 9 inches thick. The underlying material to a depth of 44 inches is fine sandy loam. The upper part is pale brown, and the lower part is light gray and calcareous. Below this to a depth of more than 60 inches is white, calcareous sandstone. In cultivated areas 15 to 30 percent of this soil is eroded. In these areas erosion has removed all or most of the original surface soil, and tillage has mixed the remaining surface soil with the subsoil. In some places the

surface layer is light in color and calcareous. In other places the surface layer is very fine sandy loam or loamy very fine sand.

Included with this soil in mapping are small areas of Jayem, Satanta, Tassel, and Tuthill soils. Jayem soils do not have sandstone within a depth of 60 inches and are on similar landscapes as the Busher soil. Satanta and Tuthill soils have more clay in the subsoil than the Busher soil and are not underlain by sandstone. These soils are on similar landscapes. Tassel soils are 6 to 20 inches deep to calcareous sandstone and are slightly higher on the landscape than the Busher soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Busher soil, and available water capacity is moderate. Organic matter content is moderately low. Runoff is slow. The water intake rate is moderately high.

Most of the acreage of this soil is farmed. The rest is used for range. The cultivated areas are either dryland farmed or irrigated.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Water erosion and soil blowing are the principal hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, help to control soil blowing and water erosion and conserve soil moisture. Cover crops help reduce runoff and control erosion. Terracing and contour farming are also effective in controlling water erosion and conserving soil moisture. Returning crop residue to the soil helps improve the organic matter content and the water intake rate.

If irrigated by a sprinkler system, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. This soil is poorly suited to gravity irrigation systems because of the moderately high water intake rate and the slope. Soil blowing and water erosion are the principal hazards. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control water erosion and soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water leach plant nutrients below the root zone and result in the hazard of water erosion on the slopes.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. This soil is subject to water erosion. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants is very effective in controlling soil blowing and water erosion. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. As a result, soil blowing is excessive and small blowouts can form. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants. Range seeding may be needed to stabilize severely eroded areas of cropland.

This soil is suited to the trees and shrubs planted in windbreaks. Erosion is the main hazard affecting the establishment of windbreaks. Water erosion and soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. The weeds and undesirable grasses in the tree rows can be controlled by the careful use of the appropriate kind of herbicide or hoeing by hand. Cultivation between the tree rows with conventional equipment can control undesirable grasses and weeds in areas where strips of sod and cover crops are not used. The lack of adequate rainfall in summer is also a hazard affecting the survival of young trees. Irrigation can provide supplemental moisture during periods of low rainfall.

The use of this soil for septic tank absorption fields is limited by depth to bedrock. Mounding the sites for absorption fields on several feet of suitable fill material improves the filtering capacity of the soil. Buildings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. The sides of shallow excavations can cave in unless they are shored. This soil is generally suited to roads.

The land capability units are IIIe-3, dryland, and

IIIe-8, irrigated; Sandy range site; and windbreak suitability group 5.

BsD—Busher fine sandy loam, 6 to 9 percent slopes. This deep, strongly sloping, well drained soil is on uplands. The soil formed in material weathered from calcareous sandstone. Areas range from 5 to 200 acres in size.

Typically, the surface layer is dark grayish brown, very friable fine sandy loam about 12 inches thick. The subsoil is grayish brown, very friable fine sandy loam about 8 inches thick. The underlying material to a depth of 42 inches is white, calcareous fine sandy loam. Below this to a depth of more than 60 inches is white, calcareous sandstone. In some places the surface layer is loamy very fine sand or loamy fine sand. In some areas the sandstone is at a depth of 20 to 40 inches. In cultivated areas 20 to 35 percent of this soil is eroded. In these areas erosion has removed all or most of the original surface soil, and tillage has mixed the remaining surface soil with the subsoil. In most places the surface layer is light in color and calcareous.

Included with this soil in mapping are small areas of Jayem, Satanta, Tassel, Tuthill, and Valent soils. Jayem soils do not have sandstone within a depth of 60 inches and are on similar landscapes as the Busher soil. Satanta and Tuthill soils have more clay in the subsoil than the Busher soil and are not underlain by sandstone. These soils are on similar landscapes. Tassel soils are 6 to 20 inches deep to calcareous sandstone and are higher on the landscape than the Busher soil. Valent soils have more sand than the Busher soil and are not underlain by sandstone. These soils are higher on the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Busher soil, and available water capacity is moderate. The organic matter content is moderately low. Runoff is medium. The water intake rate is moderately high.

Most of the acreage of this soil is used as rangeland. The rest is farmed. Most of the cultivated areas are used for dryland farming, but a few areas are irrigated.

If dryland farmed, this soil is poorly suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be grown. Water erosion and soil blowing are the principal hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, help to control soil blowing and water erosion. Because of the moderate available water capacity, these tillage practices also help to conserve soil moisture. Stripcropping, terraces, and annual cover crops help to control soil blowing and water erosion.

If irrigated by a sprinkler system, this soil is poorly suited to corn, small grains, alfalfa, and introduced grasses. This soil is best suited to sprinkler irrigation because of the moderately high water intake rate and the slope. Soil blowing and water erosion are the principal hazards on unprotected surfaces. A system of conservation tillage, such as no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. Cover crops also help to control erosion. Returning crop residue to the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water result in the hazard of water erosion on the slopes and leach plant nutrients below the root zone.

If this soil is used for range or native hay, the climax vegetation is dominantly prairie sandreed, sand bluestem, needleandthread, and little bluestem. These species make up 75 percent or more of the total annual forage. Blue grama, switchgrass, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, prairie sandreed, blue grama, Scribner panicum, sand dropseed, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. This soil is generally the first to be overgrazed in a pasture that includes the Sands or Choppy Sands range sites. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain healthy and vigorous.

This soil is suited to the trees and shrubs planted in windbreaks. Erosion is the main hazard affecting the establishment of windbreaks. Water erosion and soil blowing can be controlled by maintaining strips of sod

or a cover crop between the tree rows. The weeds and undesirable grasses in the tree rows can be controlled by the careful use of the appropriate kind of herbicide or hoeing by hand. Cultivation between the tree rows with conventional equipment can control undesirable grasses and weeds in areas where strips of sod and cover crops are not used. The lack of adequate rainfall in summer is also a hazard affecting the survival of young trees. Irrigation can provide supplemental moisture during periods of low rainfall.

The use of this soil for septic tank absorption fields is limited by depth to bedrock. Mounding the sites for absorption fields on several feet of suitable fill material improves the filtering capacity of the soil. Buildings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. The sides of shallow excavations can cave in unless they are shored. This soil is generally suited to roads.

The land capability units are IVe-3, dryland, and IVe-8, irrigated; Sandy range site; and windbreak suitability group 5.

BvC—Busher-Tassel complex, 0 to 6 percent slopes. These nearly level to gently sloping, well drained soils are on uplands. They formed in loamy material weathered from calcareous sandstone. The Busher soil is deep and on broad ridgetops and the lower side slopes. The Tassel soil is shallow and on the upper side slopes and narrow ridgetops. Areas range from 5 to 110 acres in size. They consist of 50 to 60 percent Busher soil and 25 to 35 percent Tassel soil. These soils are so intricately mixed that separating them in mapping is not practical.

Typically, the Busher soil has a surface layer of dark grayish brown, very friable fine sandy loam about 17 inches thick. The subsoil is grayish brown, very friable very fine sandy loam about 18 inches thick. The underlying material to a depth of 42 inches is white, calcareous fine sandy loam. Below this to a depth of more than 60 inches is calcareous sandstone. In some places the surface layer is loamy very fine sand or loamy fine sand. In some areas the sandstone bedrock is at a depth of 20 to 40 inches. In other areas the dark surface layer is less than 7 inches thick. In a few areas the subsoil is finer textured. In cultivated areas 15 to 30 percent of this soil is eroded. In these areas erosion has removed all or most of the original surface soil, and tillage has mixed the remaining surface soil with the subsoil. In most places the surface layer is light in color and calcareous.

Typically, the Tassel soil has a surface layer of dark grayish brown, very friable, calcareous fine sandy loam about 5 inches thick. The underlying material is brown, calcareous fine sandy loam to a depth of 13 inches. Below this is white, calcareous, fine grained sandstone. In cultivated areas erosion has removed all or most of the original surface soil, and the thickness of the loamy material over the sandstone bedrock has been reduced. In these areas numerous sandstone fragments have been dislodged by tillage equipment and are on the surface. The surface layer of these areas is light in color and calcareous. In some places the surface layer is loamy fine sand or very fine sandy loam.

Included with these soils in mapping are small areas of Satanta and Valent soils and areas of rock outcrop. Satanta soils have more clay in the subsoil than the Busher and Tassel soils and do not have sandstone within a depth of 60 inches. These soils are on similar landscapes as the Busher soil. Valent soils have more sand than the Busher and Tassel soils and do not have sandstone within a depth of 60 inches. These soils are on similar landscapes as the Busher soil. Areas of rock outcrop have exposed sandstone or less than 6 inches of soil material over the sandstone and are higher on the landscape than the Busher and Tassel soils. Included soils make up 10 to 15 percent of the unit.

Permeability is moderately rapid in the Busher and Tassel soils. Available water capacity is moderate in both soils. The organic matter content is moderately low in both soils. Runoff is medium on both soils. The water intake rate is moderately high in both soils. Root development is restricted by the underlying sandstone in the Tassel soil.

Most of the acreage of these soils is used for range. The rest is used for dryland farming.

If dryland farmed, the Busher soil is suited to small grains, introduced grasses, and alfalfa. The lack of sufficient rainfall limits the cultivated crops that can be successfully grown. Soil blowing is a serious hazard. A system of conservation tillage, such as stubble mulching and ecofallow, helps to control soil blowing and conserve soil moisture. Stripcropping and planting annual cover crops are other suitable practices. Because of the shallow depth to bedrock in areas of the Tassel soil, constructing terraces is difficult. Summer fallowing conserves moisture for use during the following growing season.

If irrigated by a sprinkler system, the Busher soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. This soil is poorly suited to gravity irrigation because of the moderately high intake rate and the slope. If a gravity irrigation system is used, the soils need to be leveled to a suitable grade so that water movement and intake rate are uniform. Soil blowing and water erosion are the

principal hazards. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to prevent erosion and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water leach plant nutrients below the root zone.

The Tassel soil is too shallow and droughty for use as cropland, but in some places it is farmed along with areas of the deeper Busher soil.

These soils are suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, into dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. This soil is subject to water erosion. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Continuous heavy grazing and improper haying also reduce the amount of protective cover and can result in soil blowing and the formation of small gullies and rills after heavy rains. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

If these soils are used for range or native hay, the climax vegetation on the Busher soil is dominantly prairie sandreed, sand bluestem, needleandthread, and little bluestem. These species make up 75 percent or more of the total annual forage. Blue grama, switchgrass, and forbs make up the rest. The climax vegetation on the Tassel soil is dominantly little bluestem, sideoats grama, western wheatgrass, blue grama, hairy grama, sand bluestem, big bluestem, and threadleaf sedge. These species make up 60 percent or more of the total annual forage. Prairie sandreed, needleandthread, green needlegrass, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, little bluestem, and switchgrass decrease in abundance on the Busher soil and little bluestem and switchgrass decrease in abundance on the Tassel soil. They are replaced by needleandthread, prairie sandreed, blue grama, Scribner panicum, sand dropseed, and forbs on the Busher soil and sideoats grama, blue grama, hairy grama, prairie sandreed, sand dropseed, threadleaf sedge, and forbs on the Tassel soil. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive. Woody plants may invade the site on the Tassel soil.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre on the Busher soil and 0.5 animal unit month per acre on the Tassel soil. The stocking rate is determined by the percentage of each soil in the pasture. The range should be closely monitored during use and the stocking rates adjusted so that one soil does not become overgrazed. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If these soils are used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain healthy and vigorous.

The Busher soil is suited to the trees and shrubs planted in windbreaks. Soil blowing is the main hazard affecting the establishment of windbreaks. It can be controlled by maintaining strips of sod or a cover crop between the tree rows. The weeds and undesirable grasses in the tree rows can be controlled by the careful use of the appropriate kind of herbicide or hoeing by hand. Cultivation between the tree rows with conventional equipment can control undesirable grasses and weeds in areas where strips of sod and cover crops are not used. The lack of adequate rainfall in summer is also a hazard affecting the survival of young trees. Supplemental water may be needed during dry periods.

The Tassel soil is generally not suited to the trees and shrubs planted in windbreaks because of the shallow depth to bedrock and the moderate available water capacity. Onsite investigation is needed to identify the areas best suited to windbreaks.

In areas of the Busher soil, mounding the sites for septic tank absorption fields on several feet of suitable fill material improves the filtering capacity of the soil. The Tassel soil is generally not suited to sanitary

facilities because of the shallow depth to bedrock. The Busher soil is generally suited to building sites and roads. In areas of the Tassel soil, the soft bedrock can be excavated during the construction of dwellings with basements, buildings that have deep foundations, and roads. In areas of the Busher soil, the sides of shallow excavations can cave in unless they are shored. Onsite investigation is needed before any engineering practices are applied.

The land capability units are IIIe-3, dryland, and IIIe-8, irrigated, for the Busher soil and VIs-4, dryland, for the Tassel soil. The Busher soil is in the Sandy range site and windbreak suitability group 5. The Tassel soil is in the Shallow Limy range site and windbreak suitability group 10.

BvF—Busher-Tassel complex, 6 to 30 percent slopes. These strongly sloping to steep, well drained soils are on uplands. They formed in loamy material weathered from calcareous sandstone. The deep Busher soil is on the wider ridgetops and the lower side slopes, and the shallow Tassel soil is on convex knolls and ridgetops and the upper side slopes. Areas range from 5 to 400 acres in size. They are about 40 to 60 percent Busher soil and 20 to 40 percent Tassel soil. These soils are so intricately mixed that separating them in mapping is not practical.

Typically, the Busher soil has a surface layer of very friable fine sandy loam about 10 inches thick. It is dark grayish brown in the upper part and dark brown in the lower part. The subsoil is dark brown, very friable fine sandy loam about 8 inches thick. The underlying material extends to a depth of 44 inches. The upper part is pale brown, calcareous fine sandy loam, and the lower part is white, calcareous loamy very fine sand. Below this to a depth of more than 60 inches is white, calcareous, fine grained sandstone. In places the surface layer is loamy very fine sand or loamy fine sand. In some areas the sandstone bedrock is at a depth of 20 to 40 inches. In other areas the dark surface layer is less than 7 inches thick.

Typically, the Tassel soil has a surface layer of dark grayish brown, very friable, calcareous fine sandy loam about 3 inches thick. The underlying material is light brownish gray, calcareous fine sandy loam to a depth of about 10 inches. Below this to a depth of more than 60 inches is white, calcareous, fine grained sandstone. In some places the surface layer is loamy fine sand or very fine sandy loam.

Included with these soils in mapping are small areas of Satanta, Vetal, and Valent soils and areas of rock outcrop. Satanta, Valent, and Vetal soils do not have calcareous sandstone within a depth of 60 inches. Satanta and Valent soils are on similar landscapes as the Busher soil. Vetal soils have a dark surface soil more than 20 inches thick and are on the lower foot slopes and in swales. Areas of rock outcrop have exposed sandstone bedrock or less than 6 inches of soil material over bedrock and are higher on the landscape than the Busher and Tassel soils. Included soils make up 15 to 20 percent of the unit.

Permeability is moderately rapid in the Busher and Tassel soils. Available water capacity is moderate in the Busher soil and very low in the Tassel soil. Runoff is rapid. The organic matter content is moderately low in both soils. Root development is restricted by the underlying bedrock in the Tassel soil.

Nearly all of the acreage of these soils is used as rangeland. These soils are not suitable for farming because of the steep slope and the shallow root zone of the Tassel soil.

If these soils are used for range or native hay, the climax vegetation on the Busher soil is dominantly prairie sandreed, sand bluestem, needleandthread, and little bluestem. These species make up 75 percent or more of the total annual forage. Blue grama, switchgrass, and forbs make up the rest. The climax vegetation on the Tassel soil is dominantly sand bluestem, needleandthread, and little bluestem. These species make up 45 percent or more of the total annual forage. Blue grama, prairie sandreed, switchgrass, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, little bluestem, and switchgrass decrease in abundance on the Busher soil and little bluestem and switchgrass decrease in abundance on the Tassel soil. They are replaced by needleandthread, prairie sandreed, blue grama, Scribner panicum, sand dropseed, and forbs on the Busher soil and sideoats grama, blue grama, hairy grama, prairie sandreed, sand dropseed, threadleaf sedge, and forbs on the Tassel soil. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive. Woody plants may invade the site on the Tassel soil.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre on the Busher soil and 0.5 animal unit month per acre on the Tassel soil. The stocking rate is determined by the percentage of each soil in the pasture. The range should be closely monitored during use and the stocking rates adjusted so that one soil does not become overgrazed. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a

more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If these soils are used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain healthy and vigorous.

These soils are generally not suited to the trees and shrubs planted in windbreaks because of the slope and the shallow depth to bedrock in areas of the Tassel soil. A few areas can be used for the trees and shrubs that enhance recreational areas or wildlife habitat if they are planted by hand or if other special management is used.

These soils are generally not suited to sanitary facilities because of the slope and the shallow depth to bedrock in areas of the Tassel soil. A suitable alternative site should be selected. Dwellings and buildings need to be properly designed so that they conform to the natural slope of the land, or the soil can be graded to an acceptable gradient. In areas of the Tassel soil, the soft bedrock can be excavated during the construction of dwellings with basements or buildings that have deep foundations. In areas of the Busher soil, the sides of shallow excavations can cave in unless they are shored. Cutting and filling generally can provide a suitable grade for roads. The soft bedrock can be excavated during the construction of roads in areas of the Tassel soil. Onsite investigation is needed before any engineering practices are applied.

The land capability unit is VIe-3, dryland, for the Busher soil and VIs-4, dryland, for the Tassel soil. The Busher soil is in the Sandy range site and windbreak suitability group 10. The Tassel soil is in the Shallow Limy range site and windbreak suitability group 10.

Ca—Calamus loamy fine sand, 0 to 2 percent slopes. This very deep, nearly level, moderately well drained soil is on bottom land along the Niobrara River and its tributaries. It is subject to rare flooding. This soil formed in sandy alluvium. Areas range from 5 to 75 acres in size.

Typically, the surface layer is grayish brown, very friable loamy fine sand about 9 inches thick. The transitional layer is light brownish gray, loose fine sand about 9 inches thick. The underlying material is light gray fine sand to a depth of more than 60 inches. The lower part has strata of grayish brown fine sandy loam and loamy fine sand and yellowish brown mottles. In some places the surface layer is fine sand or loamy sand. In other places the soil is calcareous throughout the profile.

Included with this soil in mapping are small areas of Almeria and Bolent soils. Almeria soils are very poorly drained and are lower on the landscape than the Calamus soil. Bolent soils are somewhat poorly drained and are lower on the landscape than the Calamus soil. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Calamus soil, and available water capacity is low. The organic matter content is low. Runoff is slow. The water intake rate is very high. The seasonal high water table ranges from a depth of about 3 feet during wet years to about 6 feet during dry years.

Most areas of this soil are used as range or hayland. A few areas along the Niobrara River are covered by trees and shrubs. The dominant vegetation is cottonwood, green ash, and buckbrush.

This soil is too droughty for dryland farming.

If irrigated by a sprinkler system, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. This soil is too sandy for gravity irrigation. Soil blowing is the principal hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone. This soil needs timely applications of irrigation water because of the low available water capacity.

If this soil is used as range or hayland, the climax vegetation is dominantly sand bluestem, little bluestem, prairie sandreed, needleandthread, and switchgrass. These species make up 75 percent or more of the total annual forage. Blue grama, prairie junegrass, bluegrass, indiangrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, indiangrass, little bluestem, and switchgrass decrease in abundance and are replaced by prairie sandreed, needleandthread, sand dropseed, blue grama, sedges, and forbs. If overgrazing continues for many years, blue grama, sand dropseed, needleandthread, Scribner panicum, sedges, and forbs dominate the site. Under these conditions, the native plants lose vigor and are unable to stabilize the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition.

Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, mowing should be regulated so that the grasses remain healthy and vigorous. The forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range.

This soil is suited to the trees and shrubs planted in windbreaks. Soil blowing is the main hazard affecting the establishment of windbreaks. Trees need to be planted in shallow furrows with as little disturbance of the soil as possible. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. The weeds and undesirable grasses in the tree rows can be controlled by careful use of the appropriate kind of herbicide or hoeing by hand. The lack of adequate rainfall in summer is also a hazard affecting the survival of young trees. Irrigation can provide supplemental moisture during periods of low rainfall.

The hazard of rare flooding needs to be considered if this soil is used for sanitary facilities and building sites. This soil easily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. A suitable alternative site should be selected. Constructing dwellings and buildings on raised, well compacted fill material helps to prevent the damage caused by floodwater. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate side ditches, and installing culverts help protect roads from the damage caused by floodwater. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. The shoring should take place during dry periods.

The land capability units are VIe-5, dryland, and IVe-11, irrigated; Sandy range site; and windbreak suitability group 7.

Cr—Crowther loam, 0 to 1 percent slopes. This very deep, nearly level, poorly drained soil is in sandhill valleys. It formed in calcareous loamy and sandy alluvium. It is subject to rare flooding. Areas range from 20 to 100 acres in size.

Typically, the surface layer is gray, calcareous loam 3 inches thick. The subsurface layer is light gray, friable, calcareous clay loam and loam about 15 inches thick. The transitional layer is light gray, mottled, very friable, calcareous sandy clay loam about 10 inches thick. The underlying material is light gray, mottled fine sand to a depth of more than 60 inches. In some places the solum is 8 to 20 inches thick. In some areas this soil is very poorly drained. In other areas the underlying material has strata of fine sandy loam.

Included with this soil in mapping are small areas of the coarser textured and better drained Els and Wildhorse soils, which are slightly higher on the landscape than the Crowther soil. Also included are Marlake soils in small depressions in areas where the water table is above the surface for most of the growing season. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the solum in the Crowther soil and rapid in the underlying material. Available water capacity is moderate. The organic matter content is very high. Runoff is very slow. The seasonal high water table ranges from the surface during wet years to a depth of about 1.5 feet during dry years. It can recede to a depth of 3.5 to 4.5 feet in late summer in some places.

All of the acreage of this soil is used for grazing or hayland (fig. 10). This soil is not suited to farming because of the wetness caused by the seasonal high water table.

If this soil is used as range or hayland, the climax vegetation is dominantly big bluestem, indiangrass, prairie cordgrass, and switchgrass. These species make up 60 percent or more of the total annual forage. Sedges, rushes, bluegrass, slender wheatgrass, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, big bluestem, prairie cordgrass, switchgrass, and indiangrass decrease in abundance and are replaced by slender wheatgrass, western wheatgrass, plains muhly, and sedges. If overgrazing or improper haying continues for many years, bluegrass, western wheatgrass, sedges, rushes, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 1.8 animal unit months per acre. A planned grazing system that includes proper grazing use, timely deferments from grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. Areas of this soil are generally the first to be overgrazed in a pasture that includes the better drained, sandy soils. Properly located fences and livestock watering and salting facilities result in a more uniform distribution of grazing. During wet periods, grazing and operating heavy machinery cause surface compaction and the formation of small mounds and ruts, which make grazing or harvesting hay difficult.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. Large

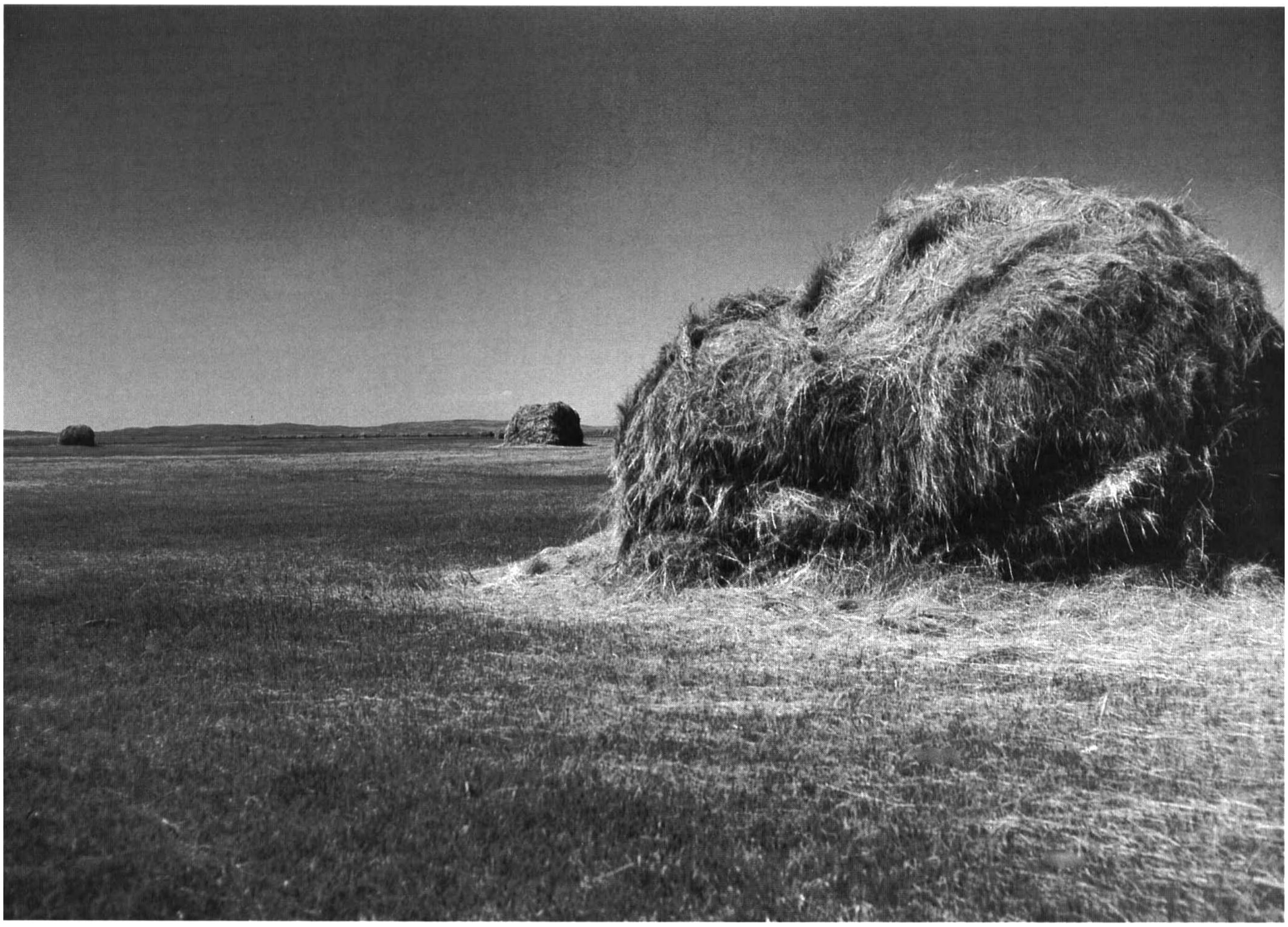


Figure 10.—A native hay meadow in an area of Crowther loam, 0 to 1 percent slopes.

meadows can be divided into three sections and the sections mowed in rotation. The order in which the sections are mowed should be changed in successive years. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in the spring before the ground thaws and the water table reaches a high level.

This soil is suited to the trees and shrubs planted in windbreaks if the species selected can tolerate the occasional wetness. The main limitation affecting the establishment of windbreaks is the wetness caused by the high water table. Tilling the soil and planting seedlings should be delayed until after the soil has begun to dry. The weeds and undesirable grasses can be controlled by cultivation between the tree rows with conventional equipment and by the use of the appropriate kind of herbicide in the tree rows.

This soil is not suited to septic tank absorption fields or building sites because of the wetness and the rare flooding. A suitable alternative site should be selected. The sides of shallow excavations can cave in unless they are shored. The shoring should take place during dry periods. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate side ditches, and installing culverts help protect roads from the damage caused by wetness and flooding. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The land capability unit is Vw-7, dryland; Wet Subirrigated range site; and windbreak suitability group 2D.

Cs—Crowther loam, wet, 0 to 1 percent slopes. This very deep, nearly level, very poorly drained soil is in sandhill valleys. It formed in calcareous loamy and sandy alluvium. It is subject to rare flooding. It is occasionally ponded by water from the seasonal high

water table in the spring during wet years. Areas range from 20 to 100 acres in size.

Typically, the surface layer is grayish brown, very friable, calcareous loam about 7 inches thick. The transitional layer is calcareous and about 15 inches thick. It is light gray, firm, mottled clay loam in the upper part and light gray, very friable loam in the lower part. The underlying material is calcareous to a depth of more than 60 inches. It is light brownish gray fine sand in the upper part and light gray, mottled loamy fine sand in the lower part. In some places the underlying material has strata of fine sandy loam. In some areas the solum is only 8 to 20 inches thick. In a few areas the underlying material is loam.

Included with this soil in mapping are small areas of Els and Marlake soils. Els soils have more sand than the Crowther soil. These soils are better drained and are higher on the landscape. Marlake soils are lower on the landscape than the Crowther soil and are ponded for long periods. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the solum in the Crowther soil and rapid in the underlying material. Available water capacity is moderate. The organic matter content is very high. Runoff is ponded. The seasonal high water table ranges from about 0.5 foot above the surface during wet years to a depth of about 1.0 foot during dry years. It can recede to a depth of 2 feet or more in late summer.

All of the acreage of this soil is used for grazing or hayland. This soil is not suited to farming because of the wetness caused by the high water table.

If this soil is used as range or hayland, the climax vegetation is dominantly prairie cordgrass, bluejoint reedgrass, and northern reedgrass. These species make up 65 percent or more of the total annual forage. Sedges, bluegrass, slender wheatgrass, green muhly, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, prairie cordgrass, bluejoint reedgrass, and northern reedgrass decrease in abundance and are replaced by slender wheatgrass, bluegrass, green muhly, sedges, rushes, and forbs. If overgrazing or improper haying continues for many years, bluegrass, foxtail barley, sedges, rushes, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 2.0 animal unit months per acre. This soil produces a high quantity of low-quality forage. A planned grazing system that includes proper grazing use, timely deferments from grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. During wet periods, grazing and operating heavy machinery can cause surface compaction and the formation of mounds and ruts, which make grazing or harvesting hay difficult.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. In wet years, some areas of hay cannot be harvested. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in the spring before the ground thaws.

This soil is not suited to the trees and shrubs planted in windbreaks because of the wetness caused by the high water table. A few areas can be used for the trees and shrubs that enhance recreational areas or wildlife habitat if they tolerate the occasional wetness and are planted by hand or if other special management is used.

This soil is not suited to septic tank absorption fields or building sites because of the wetness and the ponding. A suitable alternative site should be selected. The sides of shallow excavations can cave in unless they are shored. The shoring should take place during dry periods. Constructing roads on suitable, well compacted fill material above the ponding level, providing adequate side ditches, and installing culverts help protect roads from the damage caused by the ponding and the wetness caused by the seasonal high water table. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The land capability unit is Vw-7, dryland; Wetland range site; and windbreak suitability group 10.

DuB—Dailey loamy fine sand, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, somewhat excessively drained soil is in sandhill valleys and in the transitional area between the sandhills and the loess-mantled uplands. The soil formed in eolian sand. Areas range from 5 to 180 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 9 inches thick. The subsurface layer is also dark grayish brown, very friable loamy fine sand about 6 inches thick. The transitional layer is pale brown, very friable fine sand about 11 inches thick. The underlying material is light yellowish brown and very pale brown fine sand to a depth of more than 60 inches. In some places the surface soil is more than 20 inches thick. In some areas the surface layer is fine sand or loamy sand.

Included with this soil in mapping are small areas of Jayem, Tuthill, Valent, and Vetal soils. Jayem and Tuthill soils have more silt in the profile than the Dailey soil and are well drained. These soils are on similar

landscapes. Valent soils have a dark surface layer less than 10 inches thick and are higher on the landscape than the Dailey soil. Vetal soils have more silt in the profile than the Dailey soil and have a dark surface layer more than 20 inches thick. These soils are in swales. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Dailey soil, and available water capacity is low. The organic matter content is moderately low. Runoff is slow. The water intake rate is very high.

Most of the acreage of this soil is used for range. Some areas are used for farming. These areas are mainly irrigated, but a few areas are used for dryland farming.

If dryland farmed, this soil is poorly suited to small grains, alfalfa, and introduced grasses. Inadequate rainfall in summer generally limits the cultivated crops that can be grown. Soil blowing is the principal hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, help to control soil blowing. Because of the low available water capacity, these tillage practices also help to conserve soil moisture.

If irrigated by a sprinkler system, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. This soil is too sandy for gravity irrigation. Soil blowing is the principal hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue, green manure crops, and barnyard manure into the soil helps improve the organic matter content, fertility, and tilth. The efficient use of irrigation water is a management concern because excessive amounts of water leach plant nutrients below the root zone. This soil needs timely applications of water because of the low available water capacity.

If this soil is used for range, native hay, or both, the climax vegetation is dominated by prairie sandreed, sand bluestem, needleandthread, and little bluestem. These species make up 80 percent or more of the total annual forage. Blue grama, switchgrass, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, prairie sandreed, blue grama, Scribner panicum, sand dropseed, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, soil blowing is excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. This soil is generally the first to be overgrazed in a pasture that includes the Sands or Choppy Sands range sites. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain healthy and vigorous.

This soil is suited to the trees and shrubs planted in windbreaks. Soil blowing is the main hazard affecting the establishment of windbreaks. It can be controlled by maintaining strips of sod or a cover crop between the tree rows. The weeds and undesirable grasses in the tree rows can be controlled by careful use of the appropriate kind of herbicide or by hoeing by hand. Cultivation between the tree rows with conventional equipment can control undesirable grasses and weeds in areas where strips of sod and cover crops are not used. The lack of adequate rainfall in summer is also a hazard affecting the survival of young trees. Irrigation can provide supplemental moisture during periods of low rainfall.

This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. This soil is generally suited to building sites and roads. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

The land capability units are IVe-5, dryland, and IVe-11, irrigated; Sandy range site; and windbreak suitability group 5.

DuD—Dailey loamy fine sand, 3 to 9 percent slopes. This very deep, gently sloping and strongly sloping, somewhat excessively drained soil is in the sandhills and in the transitional areas between the sandhills and the loess-mantled uplands. The soil formed in eolian sand. Areas range from 5 to 350 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 14 inches thick. The transitional layer is brown, very friable fine sand about 8 inches thick. The underlying material is brown and

grayish brown fine sand to a depth of more than 60 inches. In some places the dark surface soil is more than 20 inches thick. In some areas the surface layer is fine sand or loamy sand.

Included with this soil in mapping are small areas of Jayem, Tuthill, and Valent soils. Jayem and Tuthill soils have a finer textured subsoil and are well drained. These soils are on similar landscapes as the Dailey soil. Valent soils have a dark surface layer less than 10 inches thick and are higher on the landscape than the Dailey soil. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Dailey soil, and available water capacity is low. The organic matter content is moderately low. Runoff is slow and medium. The water intake rate is very high.

Nearly all of the acreage of this soil is used for range. In a few cultivated acres irrigation is used. Soil blowing is a severe hazard. The low available water capacity is a severe limitation.

This soil is too sandy and droughty for dryland farming.

If irrigated by a sprinkler system, this soil is poorly suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. This soil is not suited to gravity irrigation systems. Soil blowing is the principal hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water leach plant nutrients below the root zone. This soil needs light, frequent applications of irrigation water because of the low available water capacity.

If this soil is used for range or native hay, the climax vegetation is dominantly prairie sandreed, sand bluestem, needleandthread, and little bluestem. These species make up 80 percent or more of the total annual forage. Blue grama, switchgrass, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, prairie sandreed, blue grama, Scribner panicum, sand dropseed, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range.

This soil is suited to the trees and shrubs planted in windbreaks. Soil blowing is a severe hazard. Trees need to be planted in shallow furrows with as little disturbance of the soil as possible. Soil blowing can be controlled by maintaining strips of sod or cover crops between the tree rows. Insufficient rainfall in summer is a hazard affecting the survival of young trees. Irrigation can provide supplemental moisture during periods of low rainfall. The weeds and undesirable grasses in the tree rows can be controlled by careful use of the appropriate kind of herbicide or by hoeing by hand.

This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. This soil is generally suited to roads. Buildings and dwellings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

The land capability units are VIe-5, dryland, and IVe-11, irrigated; Sandy range site; and windbreak suitability group 7.

Dw—Duroc loam, 0 to 1 percent slopes. This very deep, nearly level, well drained soil occurs in upland swales and on stream terraces. It is subject to rare flooding. The soil formed in local loamy alluvial and colluvial sediments and loess. Areas range from 5 to 300 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 8 inches thick. The subsurface layer is grayish brown, friable loam about 21 inches thick. The next layer is light brownish gray, friable loam about 21 inches thick. The underlying material is light gray, calcareous loam to a depth of 60 inches or more. In some places the dark surface soil is less than 20 inches thick. In other places the lower part of the dark surface soil is calcareous.

Included with this soil in mapping are small areas of Keya, Lodgepole, McCook, and Vetal soils. Keya and

Lodgepole soils have more clay in the subsoil than the Duroc soil. Keya soils are slightly higher on the landscape than the Duroc soil. Lodgepole soils are lower on the landscape and are ponded for short periods. McCook soils are stratified and are slightly lower on the landscape than the Duroc soil. Vetal soils have more sand in the profile than the Duroc soil and are on similar landscapes. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Duroc soil, and available water capacity is high. The organic matter content is moderate. Runoff is slow. The water intake rate is moderate.

Nearly all of the acreage of this soil is farmed. Dryland farming and irrigation are used on this soil. A few small areas are used as range.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be grown. Soil blowing is a hazard in areas where the surface is not adequately protected by crops or crop residue. This soil is flooded for very brief periods, and crop damage is minimal. In some years crops benefit from the additional moisture. A system of conservation tillage, such as stubble mulching and ecofallow, helps to conserve soil moisture and control soil blowing. Cover crops also help to control erosion. Returning crop residue to the soil helps to maintain the organic matter content and improves the water intake rate.

If irrigated, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. Some land leveling is generally needed if gravity systems are used so that water movement and intake rate are uniform. Soil blowing is the principal hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue into the soil helps to maintain the organic matter content and fertility. Irrigation systems need to be designed so the water application rate does not exceed the moderate intake rate of this soil. A tailwater recovery system can be used to conserve water.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range and hayland. A cover of range plants is effective in controlling soil blowing and water erosion. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants.

This soil is suited to the trees and shrubs planted in windbreaks. Seedlings can survive and grow if competing vegetation is controlled or removed by cultivation between the tree rows or by careful use of the appropriate kind of herbicide. Planting an annual cover crop between the tree rows helps to control soil blowing. Irrigation can provide supplemental moisture during periods of low rainfall.

The hazard of rare flooding should be considered if this soil is used for sanitary facilities and building sites. The moderate permeability of this soil is a limitation affecting septic tank absorption fields, but increasing the size of the absorption field can generally overcome this limitation. Constructing dwellings and buildings on raised, well compacted fill material helps to prevent the damage caused by floodwater. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate side ditches, and installing culverts help protect roads from the damage caused by floodwater. A good surface drainage system can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. Mixing the base material with additives, such as hydrated lime, helps to prevent excessive shrinking and swelling.

The land capability units are IIc-1, dryland, and I-6, irrigated; Silty Lowland range site; and windbreak suitability group 1.

DwB—Duroc loam, 1 to 3 percent slopes. This very deep, very gently sloping, well drained soil is on toe slopes. This soil formed in local loamy alluvial and colluvial sediments and loess. Areas range from 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable loam about 6 inches thick. The subsurface layer is friable loam about 26 inches thick. The upper part is dark grayish brown, and the lower part is light brownish gray. The underlying material is light gray, calcareous loam to a depth of 60 inches or more. In some places the dark surface soil is less than 20 inches thick. A few areas have a silty clay loam subsoil and dark buried layers.

Included with this soil in mapping are small areas of Keya and Vetal soils. Keya soils have more clay in the subsoil than the Duroc soil and are slightly higher on the landscape. Vetal soils have more sand in the profile than the Duroc soil and are on similar landscapes. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Duroc soil, and available water capacity is high. The organic matter content is moderate. Runoff is slow. The water intake rate is moderate.

Nearly all of the acreage of this soil is farmed. Dryland farming and irrigation are used on this soil. A few small areas are used as range.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Water erosion and soil blowing are hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to conserve soil moisture and control erosion. Cover crops also help to control erosion. Returning crop residue to the soil helps to maintain the organic matter content and improves the water intake rate.

If irrigated, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. Some land leveling is generally needed if gravity systems are used so that water movement and intake rate are uniform. Water erosion and soil blowing are the principal hazards. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control erosion and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue into the soil helps to maintain the organic matter content and fertility. Irrigation systems need to be designed so the water application rate does not exceed the moderate intake rate of this soil. A tailwater recovery system can be used to conserve water.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range and hayland. A cover of range plants very effectively controls soil blowing and water erosion. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and soil erosion are the principal hazards affecting seedlings and young trees. Seedlings can survive and grow if competing vegetation is controlled or removed by cultivation between the tree rows or by careful use of the appropriate kind of herbicide or hoeing by hand in the tree rows. Planting an annual cover crop between the tree rows helps to control soil blowing. Irrigation can provide supplemental moisture during periods of low rainfall.

The moderate permeability of this soil is a limitation affecting septic tank absorption fields, but increasing the size of the absorption field can generally overcome this limitation. Strengthening the foundations of buildings and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. Mixing the base material with additives, such as hydrated lime, helps to prevent excessive shrinking and swelling.

The land capability units are IIe-1, dryland, and IIe-6, irrigated; Silty range site; and windbreak suitability group 3.

Ec—Els fine sand, calcareous, 0 to 2 percent slopes. This very deep, nearly level, somewhat poorly drained soil is in sandhill valleys. The soil formed in eolian sand and sandy alluvium. It is subject to rare flooding. Individual areas range from 20 to 200 acres in size.

Typically, the surface layer is gray, very friable fine sand about 7 inches thick. The transitional layer is grayish brown, very friable, mottled fine sand about 6 inches thick. The underlying material is pale brown, mottled fine sand to a depth of more than 60 inches. It is calcareous throughout. In some areas the surface layer is loamy fine sand. In other areas the underlying material has strata of fine sandy loam or loamy fine sand. In a few places a dark surface soil is more than 10 inches thick.

Included with this soil in mapping are small areas of Ipage, Tryon, Valent, and Valentine soils. Ipage, Valent, and Valentine soils are better drained than the Els soil and are higher on the landscape. Tryon soils are lower on the landscape than the Els soil and are poorly drained. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Els, calcareous, soil, and available water capacity is low. The organic matter content is low. Runoff is slow. The water intake rate is very high. The seasonal high water table ranges from a depth of 1.5 feet during wet years to 3.0 feet during dry years.

Nearly all of the acreage of this soil is used as range or hayland. A few areas are used as irrigated cropland. Soil blowing and the wetness caused by the high water table are severe hazards.

This soil is not suited to dryland farming because of the hazard of soil blowing.

If irrigated by a sprinkler system, this soil is poorly suited to corn, alfalfa, and introduced grasses. This soil is too sandy for gravity irrigation systems. Soil blowing is a severe hazard on unprotected surfaces. This soil dries out slowly in the spring, and tillage and planting are delayed because of the wetness. A system of conservation tillage, such as no-till, keeps crop residue on the surface and helps to control soil blowing and conserve moisture. Cover crops also help to control soil blowing. Returning crop residue to the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water leach plant nutrients below the root zone. This soil needs frequent applications of irrigation water because of the low available water capacity.

If this soil is used as range or hayland, the climax vegetation is dominated by big bluestem, little bluestem, indiangrass, switchgrass, and various sedges. These species make up 75 percent or more of the total annual forage. Prairie cordgrass, bluegrass, rushes, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, big bluestem, little bluestem, indiangrass, switchgrass, and prairie cordgrass decrease in abundance and are replaced by western wheatgrass, bluegrass, slender wheatgrass, green muhly, sedges, and rushes. If overgrazing or improper haying continues for many years, bluegrass, sedges, rushes, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 1.6 animal unit months per acre. A planned grazing system that includes proper grazing use, timely deferments from grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. Areas of this soil are generally the first to be overgrazed in a pasture that includes the better drained, sandy soils. Properly located fences and livestock watering and salting facilities result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. The hay is of best quality when the grasses are cut early. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in the spring before the ground thaws.

This soil is suited to the trees and shrubs planted in windbreaks. The main limitation affecting the establishment of windbreaks is the wetness caused by the high water table. The species selected for planting should be those that withstand the occasional wetness. Tilling and planting seedlings should be delayed until after the soil has begun to dry. The weeds and undesirable grasses can be controlled by cultivation between the tree rows with conventional equipment and by the use of the appropriate kind of herbicide in the tree rows.

The hazard of rare flooding needs to be considered if this soil is used for sanitary facilities and building sites. Constructing septic tank absorption fields on fill material raises the field a sufficient distance above the seasonal high water table. The poor filtering capacity can result in pollution of the ground water. This soil readily absorbs but does not adequately filter the

effluent from septic tank absorption fields. Constructing dwellings and buildings on raised, well compacted fill material helps to overcome the wetness caused by the high water table and helps to prevent the damage caused by floodwater. Constructing roads on suitable, well compacted fill material, providing adequate side ditches, and installing culverts help protect roads from the wetness and the damage caused by floodwater. A good surface drainage system and a gravel moisture barrier in the subgrade can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving if the excavations are made during dry periods.

The land capability units are VIe-5, dryland, and IVw-12, irrigated; Subirrigated range site; and windbreak suitability group 2S.

Ef—Els, calcareous-Hoffland complex, 0 to 2 percent slopes. These very deep, nearly level soils are in sandhill valleys. The Els, calcareous, soil is somewhat poorly drained, and the Hoffland soil is poorly drained. They formed in eolian sand and sandy alluvium. These soils are subject to rare flooding. Areas range from 20 to 1,000 acres in size. They consist of 55 to 70 percent Els, calcareous, soil and 25 to 40 percent Hoffland soil. These soils are so intermingled or mixed that separating them in mapping is not practical.

Typically, the Els, calcareous, soil has a surface layer of gray, loose fine sand about 7 inches thick. The transitional layer is grayish brown, very friable, mottled fine sand about 8 inches thick. The underlying material is light gray, mottled fine sand to a depth of 60 inches or more. It is calcareous throughout. In some places the surface layer is loamy fine sand. In some areas the underlying material has strata of fine sandy loam or loamy fine sand.

Typically, the Hoffland soil has a surface layer of grayish brown, very friable, calcareous fine sandy loam about 3 inches thick. The subsurface layer is light brownish gray, very friable, calcareous fine sandy loam about 4 inches thick. The transitional layer is light gray, very friable, calcareous fine sandy loam about 3 inches thick. The underlying material is light brownish gray, calcareous, mottled fine sand to a depth of about 34 inches. Below this to a depth of 60 inches or more is very pale brown fine sand. In some places the dark surface layer is less than 7 inches thick. In some areas the surface layer is loam, and in a few areas it is loamy fine sand. In a few areas the solum is more than 20 inches thick.

Included with these soils in mapping are small areas of Ipage, calcareous, and Wildhorse soils. Ipage, calcareous, soils are better drained than the Els, calcareous, and Hoffland soils and are slightly higher on the landscape. Wildhorse soils have a high content of sodium and are on similar landscapes as the Els, calcareous, soil. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Els, calcareous, and Hoffland soils. Available water capacity is low in both soils. The organic matter content is low in the Els, calcareous, soil and high in the Hoffland soil. Runoff is slow on the Els, calcareous, soil and very slow on the Hoffland soil. The Els, calcareous, soil has a seasonal high water table that ranges from a depth of 1.5 feet during wet years to 3.0 feet during dry years. The Hoffland soil has a seasonal high water table that ranges from the surface during wet years to a depth of 1.5 feet during dry years.

Nearly all of the acreage of these soils is used as range and hayland.

These soils are not suited to dryland farming because of the wetness in the Hoffland soil and the severe hazard of soil blowing in the Els, calcareous, soil. The Hoffland soil is not suited to irrigation because of the wetness caused by the seasonal high water table.

If irrigated by a sprinkler system, the Els, calcareous, soil is suited to crops commonly grown in the county. Onsite investigation is needed to identify the areas that are suited to irrigation. Soil blowing is a severe hazard. A system of conservation tillage that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. Frequent, light applications of irrigation water are needed because of the low available water capacity of both soils, and they help to prevent the leaching of plant nutrients below the root zone.

If these soils are used as range or hayland, the climax vegetation on the Els, calcareous, soil is dominantly big bluestem, little bluestem, indiangrass, switchgrass, and various sedges. These species make up 75 percent or more of the total annual forage. Prairie cordgrass, bluegrass, rushes, and forbs make up the rest. The climax vegetation on the Hoffland soil is dominantly big bluestem, indiangrass, prairie cordgrass, and switchgrass. These species make up 60 percent or more of the total annual forage. Bluegrass, slender wheatgrass, sedges, rushes, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, big bluestem,

little bluestem, indiangrass, switchgrass, and prairie cordgrass decrease in abundance on both soils. They are replaced by western wheatgrass, bluegrass, slender wheatgrass, green muhly, sedges, and rushes on the Els, calcareous, soil and slender wheatgrass, western wheatgrass, plains muhly, and sedges on the Hoffland soil. Timothy, redtop, and red clover also increase in abundance if they have been overseeded on the Hoffland soil. If overgrazing or improper haying continues for many years, bluegrass, western wheatgrass, sedges, rushes, and forbs dominate the site on both soils.

If the range is in excellent condition, the suggested initial stocking rate is 1.6 animal unit months per acre on the Els, calcareous, soil and 1.8 animal unit months per acre on the Hoffland soil. The stocking rate is determined by the percentage of each soil in the pasture. The range should be closely monitored during use and the stocking rates adjusted so that one soil does not become overgrazed. A planned grazing system that includes proper grazing use, timely deferments from grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. Areas of these soils are generally the first to be overgrazed in a pasture that includes the better drained, sandy soils. Properly located fences and livestock watering and salting facilities result in a more uniform distribution of grazing. During wet periods on the Hoffland soil, grazing and operating heavy machinery cause surface compaction and the formation of small mounds and ruts, which make grazing or harvesting hay difficult. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If these soils are used as hayland, mowing should be regulated so that the grasses remain vigorous. The hay is of best quality when the grasses are cut early. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in the spring before the ground thaws and the water table reaches a high level.

These soils are suited to the trees and shrubs planted in windbreaks. The species selected for planting should be those that withstand the wetness. The excessive wetness caused by the high water table in areas of the Hoffland soil is the main limitation. Planting seedlings in the spring is difficult on this unit and generally should be delayed until the water table has receded below a depth of 2 feet. Competing vegetation in the tree rows also needs to be controlled by cultivation between the tree rows or by the use of the appropriate kind of herbicide.

The Hoffland soil is not suited to septic tank absorption fields and building sites because of the rare flooding and the wetness. A suitable alternative site should be selected. In areas of the Els, calcareous, soil, the hazard of rare flooding needs to be considered if this soil is used for sanitary facilities and building sites. Constructing septic tank absorption fields on fill material in areas of the Els, calcareous, soil raises the fields a sufficient distance above the seasonal high water table. Seepage can result in pollution of the ground water. Constructing dwellings and buildings in areas of the Els, calcareous, soil on raised, well compacted fill material helps to overcome the wetness caused by the high water table and helps to prevent the damage caused by floodwater. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate side ditches, and installing culverts help protect roads from the damage caused by floodwater and the wetness. A good surface drainage system and a gravel moisture barrier in the subgrade can minimize the damage to roads caused by frost action on these soils. Crowning the road by grading and providing adequate side ditches help to provide the needed surface drainage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving if the excavations are made during dry periods.

The land capability units are VIe-5, dryland, and IVw-12, irrigated, for the Els, calcareous, soil and Vw-7, dryland, for the Hoffland soil. The Els, calcareous, soil is in the Subirrigated range site and windbreak suitability group 2S. The Hoffland soil is in the Wet Subirrigated range site and windbreak suitability group 2D.

EgB—Els, calcareous-Ipage complex, 0 to 3 percent slopes. These very deep soils are in sandhill valleys. The Els, calcareous, soil is nearly level and somewhat poorly drained, and the Ipage soil is very gently sloping and moderately well drained. They formed in eolian sand and sandy alluvium. The Els, calcareous, soil is subject to rare flooding. Areas range from 20 to 200 acres in size. They consist of 55 to 65 percent Els, calcareous, soil and 30 to 40 percent Ipage soil. These soils are so intermingled or mixed that separating them in mapping is not practical.

Typically, the Els, calcareous, soil has a surface layer of dark grayish brown, very friable fine sand about 8 inches thick. The transitional layer is grayish brown, loose fine sand about 6 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray fine sand in the upper part, dark gray loamy fine sand in the middle part, and gray, mottled fine sand in the lower part. It is calcareous throughout. In some places the surface layer is loamy fine sand. In a few places the dark surface layer is less

than 5 inches thick. In some areas a dark surface layer is more than 10 inches thick. In other areas the profile is strongly alkaline in the lower part.

Typically, the Ipage soil has a surface layer of grayish brown, very friable fine sand about 4 inches thick. The transitional layer is brown, loose fine sand about 7 inches thick. The underlying material is pale brown and light gray fine sand to a depth of 40 inches. Below this to a depth of 60 inches or more is light gray, calcareous fine sand. In some places the dark surface layer is more than 10 inches thick. In other places the surface layer is loamy fine sand.

Included with these soils in mapping are small areas of Hoffland, Valent, Valentine, and Wildhorse soils. Hoffland soils are poorly drained and are lower on the landscape than the Els, calcareous, and Ipage soils. Valent and Valentine soils are excessively drained and are higher on the landscape than the Els, calcareous, and Ipage soils. Wildhorse soils have a high content of sodium and are on similar landscapes as the Els, calcareous, soil. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Els, calcareous, and Ipage soils. Available water capacity and the organic matter content are low in both soils. Runoff is slow. The water intake rate is very high. The Els, calcareous, soil has a seasonal high water table that ranges from a depth of 1.5 feet during wet years to 3.0 feet during dry years. The Ipage soil has a seasonal high water table that ranges from a depth of 3 feet during wet years to 5 feet during dry years.

Nearly all of the acreage of these soils is used for grazing or haying. In a few small cultivated areas sprinkler irrigation is used.

These soils are not suitable for dryland farming because of droughtiness and the hazard of soil blowing.

If irrigated by a sprinkler system, these soils are poorly suited to corn, alfalfa, small grains, and introduced grasses. They are too sandy for gravity irrigation. Soil blowing is the principal hazard on unprotected soil surfaces. The wetness caused by the high water table is also a limitation on the Els, calcareous, soil. Planting and cultivation may be delayed in the spring on the Els, calcareous, soil. A system of conservation tillage that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. Returning crop residue and barnyard manure to the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is also a management concern. Light, frequent applications of water are needed because of the low available water capacity of these soils. Excessive amounts of water leach plant nutrients below the root zone.

If these soils are used as range or hayland, the climax vegetation on the Els, calcareous, soil is dominantly big bluestem, little bluestem, indiangrass, switchgrass, and sedges. These species make up 75 percent or more of the total annual forage. Prairie cordgrass, bluegrass, rushes, and forbs make up the rest. The climax vegetation on the Ipage soil is dominantly sand bluestem, little bluestem, prairie sandreed, needleandthread, and switchgrass. These species make up 75 percent or more of the total annual forage. Blue grama, prairie junegrass, bluegrass, indiangrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, big bluestem, little bluestem, indiangrass, switchgrass, and prairie cordgrass decrease in abundance on the Els, calcareous, soil, and sand bluestem, indiangrass, little bluestem, and switchgrass decrease in abundance on the Ipage soil. They are replaced by western wheatgrass, bluegrass, slender wheatgrass, green muhly, sedges, and rushes on the Els, calcareous, soil and prairie sandreed, needleandthread, sand dropseed, blue grama, sedges, and forbs on the Ipage soil. If overgrazing or improper haying continues for many years, bluegrass, sedges, rushes, and forbs dominate the site on the Els, calcareous, soil, and blue grama, sand dropseed, needleandthread, Scribner panicum, sedges, and forbs dominate the site on the Ipage soil. Under these conditions the native plants lose vigor and are unable to stabilize the site.

If the range is in excellent condition, the suggested initial stocking rate is 1.6 animal unit months per acre on the Els, calcareous, soil and 0.9 animal unit month per acre on the Ipage soil. The stocking rate is determined by the percentage of each soil in the pasture. The range should be closely monitored during use and the stocking rates adjusted so that one soil does not become overgrazed. A planned grazing system that includes proper grazing use, timely deferments from grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. Areas of the Els, calcareous, soil are generally the first to be overgrazed in a pasture that includes the better drained, sandy soils. Properly located fences and livestock watering and salting facilities result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If these soils are used as hayland, mowing should be regulated so that the grasses remain vigorous. The

forage on the Ipage soil should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in the spring before the ground thaws.

These soils are suited to the trees and shrubs planted in windbreaks. The wetness caused by the high water table and soil blowing are the main hazards. The species selected for planting in areas of the Els, calcareous, soil should be those that withstand the wetness. Tilling and planting seedlings should be delayed until after the soil has begun to dry. Trees need to be planted in shallow furrows with as little disturbance of the soil as possible. Supplemental watering can provide needed water during periods of low rainfall. The weeds and undesirable grasses in the tree rows can be controlled by cultivation with conventional equipment, the proper applications of the appropriate kind of herbicide, or hoeing by hand.

In areas of the Els, calcareous, soil, the hazard of rare flooding needs to be considered if the soil is used for sanitary facilities and building sites. Constructing septic tank absorption fields on fill material raises the fields a sufficient distance above the seasonal high water table. Protection from flooding is needed. These soils readily absorb but do not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. The Ipage soil is generally suited to sites for dwellings and buildings without basements. Constructing dwellings with basements in areas of the Ipage soil and all buildings in areas of the Els, calcareous, soil on raised, well compacted fill material helps to overcome the wetness caused by the high water table and helps to prevent the damage caused by floodwater in areas of the Els, calcareous, soil. A good surface drainage system and a gravel moisture barrier in the subgrade can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. In areas of the Els, calcareous, soil, constructing roads on suitable, well compacted fill material above the flood level, providing adequate side ditches, and installing culverts help protect roads from the damage caused by the wetness and the flooding. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving if the excavations are made during dry periods. Onsite investigations are needed before any engineering practices are applied.

The land capability units are VIe-5, dryland, and IVw-12, irrigated, for the Els, calcareous, soil and VIe-5, dryland, and IVe-12, irrigated, for the Ipage soil. The Els, calcareous, soil is in the Subirrigated range site and windbreak suitability group 2S. The Ipage soil is in the Sandy Lowland range site and windbreak suitability group 7.

En—Els, calcareous-Tryon complex, 0 to 2 percent slopes. These very deep, nearly level soils are in sandhill valleys. The Els, calcareous, soil is somewhat poorly drained, and the Tryon soil is poorly drained. They formed in eolian sand and sandy alluvium. These soils are subject to rare flooding. Areas range from 20 to 200 acres in size. They consist of 55 to 70 percent Els, calcareous, soil and 25 to 40 percent Tryon soil. These soils are so intermingled or mixed that separating them in mapping is not practical.

Typically, the Els, calcareous, soil has a surface layer of dark grayish brown, very friable fine sand about 9 inches thick. The underlying material to a depth of 60 inches is grayish brown, calcareous, mottled fine sand in the upper part and light grayish brown and light gray, mottled fine sand in the lower part. In some places the profile is strongly alkaline in the lower part. In some areas the surface layer is loamy fine sand. In other areas the underlying material has strata of fine sandy loam or loamy fine sand. In some areas a dark surface layer is more than 10 inches thick.

Typically, the Tryon soil has a surface layer of dark gray, very friable, calcareous loamy fine sand about 4 inches thick. The subsurface layer is dark grayish brown, very friable, mottled fine sand about 5 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray, mottled fine sand. In places the solum and underlying material are calcareous. In a few places the soil is very poorly drained. In some areas the surface texture is loam or fine sandy loam. In a few areas the solum is more than 2 feet thick.

Included with these soils in mapping are small areas of Ipage soils, which are better drained than the Els, calcareous, and Tryon soils and are slightly higher on the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Els, calcareous, and Tryon soils. Available water capacity is low in both soils. Organic matter content is low in the Els, calcareous, soil and high in the Tryon soil. Runoff is slow in the Els, calcareous, soil and very slow in the Tryon soil. The Els, calcareous, soil has a seasonal high water table that ranges from a depth of 1.5 feet during wet years to 3.0 feet during dry years. The Tryon soil has a seasonal high water table that ranges from the surface during wet years to a depth of 1.5 feet during dry years.

All of the acreage of these soils is used as range and hayland.

These soils are not suitable for dryland farming because of the wetness caused by the high water table and the hazard of soil blowing. The Tryon soil is too wet for irrigation.

If irrigated by a sprinkler system, the Els, calcareous, soil is suited to the crops commonly grown in the county. It is too sandy for gravity irrigation. Onsite investigation is needed to identify the areas that are suited to irrigation. Soil blowing is the principal hazard. The wetness caused by the high water table delays planting and cultivating in the spring. A system of conservation tillage that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. Frequent, light applications of water are needed because of the low available water capacity of these soils.

These soils are suited to range and native hay. In areas of the Els, calcareous, soil, the climax vegetation is dominated by big bluestem, little bluestem, indiangrass, switchgrass, and sedges. These species make up 75 percent or more of the total annual production. Plains bluegrass, prairie cordgrass, slender wheatgrass, western wheatgrass, rushes, and some forbs make up the remaining 25 percent. If subject to continuous heavy grazing or improper haying, big bluestem, little bluestem, indiangrass, switchgrass, and prairie cordgrass decrease in abundance. Initially, these species are replaced by sideoats grama, western wheatgrass, Kentucky bluegrass, foxtail barley, slender wheatgrass, green muhly, and various sedges and rushes. Timothy, redtop, and clovers also increase in abundance if they have been overseeded. If overgrazing or improper haying continues for many years, bluegrass, sedges, rushes, clovers, and other forbs dominate the site. During wet periods, continuous heavy grazing and operating heavy machinery can cause surface compaction and can also create small mounds and ruts, which make grazing or harvesting hay difficult.

In areas of the Tryon soil, the climax vegetation is dominated by big bluestem, indiangrass, prairie cordgrass, and switchgrass. These species make up 60 percent or more of the total annual production. Bluegrass, bluejoint reedgrass, northern reedgrass, slender wheatgrass, Canada wildrye, sedges, rushes, and forbs make up the remaining 40 percent. If subject to continuous heavy grazing or improper haying, big bluestem, bluejoint reedgrass, northern reedgrass, prairie cordgrass, switchgrass, indiangrass, and reed canarygrass decrease in abundance. Initially, these plants are replaced by slender wheatgrass, plains muhly, and various sedges. Timothy, redtop, and clovers also increase in abundance if they have been overseeded. If overgrazing or improper haying continues for many years, bluegrass, western wheatgrass, foxtail barley, and various sedges, rushes, and forbs dominate the site. During wet periods, continuous heavy grazing and operating heavy machinery can cause surface compaction and can also create small mounds and ruts, which make grazing or harvesting hay difficult.

If the range is in excellent condition, the suggested initial stocking rate is 1.6 animal unit months per acre on the Els, calcareous, soil and 1.8 animal unit months per acre on the Tryon soil. A planned grazing system that includes proper grazing use, timely deferments from grazing and haying, and restricted use during very wet periods helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The areas away from the watering facilities may be underused. Properly locating fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the livestock watering facilities and relocating them each time that salt is provided helps to prevent excessive trampling and local overuse.

If these soils are used as hayland, mowing should be regulated so that the grasses remain vigorous. It should be avoided between the boot stage and seed maturity. Mowing before the dominant grasses reach the boot stage allows the plants to recover. Most of the carbohydrate storage occurs between this stage and seed maturity. Since haying generally extends over a period of several weeks, large meadows can be divided into three parts and mowed in rotation. One third should be mowed 2 weeks before seed stalks appear in the dominant plants, one third at the boot stage, and one third early in the flowering period. Grazing in the three parts should be rotated in successive years. After the ground is frozen, livestock can graze without damaging the meadows. Livestock should be removed before the ground thaws in the spring and the water table reaches a high level. A proper mowing height also helps to maintain the stand of grasses and high forage production. The mowing height should not be less than 3 inches.

These soils are suited to the trees and shrubs planted in windbreaks. The excessive wetness caused by the high water table in areas of the Tryon soil is the main limitation. Planting seedlings in the spring is difficult and generally should be delayed until the water table has receded below a depth of 2 feet. Competing vegetation in the tree rows can be controlled by cultivation with conventional equipment or by the timely applications of the appropriate kind of herbicide.

The Tryon soil is not suited to septic tank absorption fields and building sites because of the flooding and the wetness. A suitable alternative site should be selected. In areas of the Els, calcareous, soil, the hazard of rare flooding needs to be considered if this soil is used for sanitary facilities and building sites. Constructing septic tank absorption fields on fill material in areas of the Els, calcareous, soil raises the fields a sufficient distance above the seasonal high water table. Seepage can result in pollution of the ground water. Constructing dwellings in areas of the Els, calcareous, soil on fill material helps to overcome the wetness caused by the high water table and helps to prevent the damage caused by floodwater. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate side ditches, and installing culverts help protect roads from the damage caused by floodwater and the wetness. A good surface drainage system and a gravel moisture barrier in the subgrade can minimize the damage to roads caused by frost action on these soils. Crowning the road by grading and providing adequate side ditches help to provide the needed surface drainage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving if the excavations are made during dry periods. Onsite investigation is needed before any engineering practices are applied.

The land capability units are VIe-5, dryland, and IVw-12, irrigated, for the Els, calcareous, soil and Vw-7, dryland, for the Tryon soil. The Els, calcareous, soil is in the Subirrigated range site and windbreak suitability group 2S. The Tryon soil is in the Wet Subirrigated range site and windbreak suitability group 2D.

Es—Elsmere loamy fine sand, 0 to 2 percent slopes. This very deep, nearly level, somewhat poorly drained soil is in sandhill valleys. It formed in eolian sand and sandy alluvium. This soil is subject to rare flooding. Areas range from 20 to 150 acres.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 6 inches thick. The subsurface layer is very dark grayish brown, very friable loamy fine sand about 5 inches thick. The transitional layer is grayish brown, very friable loamy fine sand about 6 inches thick. The underlying material is light brownish gray and light gray, mottled fine sand to a depth of 60 inches or more. In some places the surface soil is less than 10 inches thick. In some areas the surface layer is loamy sand, fine sand, or fine sandy loam. In some areas the underlying material is calcareous.

Included with this soil in mapping are small areas of Dailey, Ipage, Valent, and Valentine soils. The included soils are higher on the landscape than the Elsmere soil and are moderately well drained to excessively drained. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Elsmere soil. Available water capacity is low. Runoff is slow. The organic matter content is moderately low. The seasonal high water table ranges from a depth of 1.5 feet during wet years to 3.0 feet during dry years. The water intake rate is very high.

Nearly all of the acreage of this soil is used for range or hay production. In a few cultivated areas sprinkler irrigation is used.

If dryland farmed, this soil is poorly suited to small grains and introduced grasses. Soil blowing is a serious hazard in areas where the surface is not adequately protected by crops or crop residue. The wetness caused by the high water table is also a limitation. Cover crops, no-till, and stubble mulching help to conserve soil moisture and control soil blowing. Planting and cultivating is generally delayed in the spring because of the wetness caused by the high water table. Incorporating crop residue into the soil helps to maintain and improve the fertility and the organic matter content.

If irrigated by a sprinkler system, this soil is poorly suited to corn, alfalfa, small grains, and introduced grasses. It is too sandy for gravity irrigation. Soil blowing is a serious hazard in areas where the soil is not adequately protected by crops or crop residue. The wetness in the spring is also a limitation. A system of conservation tillage that keeps crop residue on the surface or the use of cover crops helps to control soil blowing. Planting and cultivating is generally delayed in the spring because of the wetness of this soil. Incorporating crop residue into the soil helps to maintain and improve fertility and the organic matter content. This soil needs frequent applications of irrigation water because of the low available water capacity; however, excessive amounts of water leach plant nutrients below the root zone.

If this soil is used as range or hayland, the climax vegetation is dominantly big bluestem, little bluestem, indiangrass, switchgrass, and sedges. These species make up 70 percent or more of the total annual forage. Prairie cordgrass, bluegrass, rushes, and forbs dominate the rest. If subject to continuous heavy grazing or improperly harvested for hay, big bluestem, little bluestem, indiangrass, switchgrass, and prairie cordgrass decrease in abundance and are replaced by western wheatgrass, bluegrass, slender wheatgrass,

green muhly, sedges, and rushes. If overgrazing or improper haying continues for many years, bluegrass, sedges, rushes, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 1.6 animal unit months per acre. A planned grazing system that includes proper grazing use, timely deferments from grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. Areas of this soil are generally the first to be overgrazed in a pasture that includes the better drained, sandy soils. Properly located fences and livestock watering and salting facilities result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. The hay is of best quality when the grasses are cut early. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in the spring before the ground thaws.

This soil is suited to the trees and shrubs planted in windbreaks. The species selected should be able to tolerate the occasional wetness. The main limitation affecting the establishment of windbreaks is the wetness caused by the high water table. Tilling and planting seedlings should be delayed until after the soil has begun to dry. The weeds and undesirable grasses can be controlled by cultivation between the tree rows with conventional equipment and by the use of the appropriate kind of herbicide in the tree rows.

The hazard of rare flooding needs to be considered if this soil is used for sanitary facilities and building sites. Constructing septic tank absorption fields on fill material raises the fields a sufficient distance above the seasonal high water table. The poor filtering capacity can result in pollution of the ground water. This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving if the excavations are made during dry periods. Constructing dwellings and buildings on raised, well compacted fill material helps to overcome the wetness caused by the high water table and helps to prevent the damage caused by floodwater. A good surface drainage system and a gravel moisture barrier in the subgrade can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. Constructing roads on suitable, well compacted fill material above the level of ponding, providing adequate side ditches, and installing culverts help protect roads from the damage caused by the wetness and the flooding.

The land capability units are IVw-5, dryland, and IVw-11, irrigated; Subirrigated range site; and windbreak suitability group 2S.

EuE—Enning-Minnequa complex, 6 to 20 percent slopes. These soils are shallow and moderately deep, strongly sloping to steep, and well drained. They formed in silty, calcareous material weathered from interbedded chalk and shale. The shallow Enning soil is on ridgetops, shoulders, and the steep upper side slopes. The moderately deep Minnequa soil is on the lower side slopes. Areas range from 20 to 300 acres in size. They consist of 35 to 50 percent Enning soil and 30 to 40 percent Minnequa soil. These soils are so intermingled or mixed that separating them in mapping is not practical.

Typically, the surface layer of the Enning soil is grayish brown, friable, calcareous silty clay loam about 3 inches thick. The transitional layer is light brownish gray, friable, calcareous silty clay loam about 4 inches thick. The underlying material is light gray, friable, calcareous silty clay loam to a depth of 18 inches. Below this to a depth of more than 60 inches is white, interbedded chalk and shale. In some places the surface layer is silt loam.

Typically, the surface layer of the Minnequa soil is grayish brown, friable, calcareous silty clay loam about 4 inches thick. The transitional layer is light brownish gray, friable, calcareous silty clay loam about 6 inches thick. The underlying material to a depth of 33 inches is light brownish gray, friable, calcareous silty clay loam in the upper part and light gray, very friable, calcareous silt loam in the lower part. Below this to a depth of more than 60 inches is white, interbedded chalk and shale. In some places the surface layer is silt loam or loam.

Included with these soils in mapping are small areas of Manvel and Orella soils and areas of shale outcrop. Manvel soils are very deep and are on foot slopes and alluvial fans. Orella soils are higher on the landscape than the Enning and Minnequa soils and formed in silty shale. The areas of shale outcrop are weathered and can occur on ridges. Included areas make up 5 to 15 percent of the unit.

Permeability is moderate in the Enning and Minnequa soils. Available water capacity is very low in the Enning soil and low in the Minnequa soil. The organic matter content is moderately low in both soils. Runoff is rapid. Root development is restricted by the underlying interbedded chalk and shale in the Enning soil.

These soils support native grasses and are used as

range. They are not suitable for cropland because of the steep slope and the shallow depth to bedrock in the Enning soil.

If these soils are used as range, the climax vegetation on the Enning soil is dominantly little bluestem, sideoats grama, blue grama, and threadleaf sedge. These species make up 80 percent or more of the total annual forage. Prairie sandreed, western wheatgrass, hairy grama, sand bluestem, big bluestem, needleandthread, green needlegrass, and forbs make up the rest. The climax vegetation on the Minnequa soil is dominantly little bluestem, big bluestem, sideoats grama, and blue grama. These species make up 55 percent or more of the total annual forage. Plains muhly, buffalograss, needleandthread, western wheatgrass, and forbs make up the rest. If subject to continuous heavy grazing, little bluestem, sand bluestem, and big bluestem decrease in abundance on the Enning soil, and big bluestem and little bluestem decrease in abundance on the Minnequa soil. They are replaced by sideoats grama, blue grama, hairy grama, prairie sandreed, sand dropseed, threadleaf sedge, and forbs on the Enning soil and hairy grama, prairie sandreed, tall dropseed, western wheatgrass, needleandthread, plains muhly, sedges, and forbs on the Minnequa soil. If overgrazing continues for many years, the native grasses lose vigor and are unable to stabilize the site. As a result, water erosion is excessive. Woody plants may invade the site on the Enning soil.

If the range is in excellent condition, the suggested initial stocking rate is 0.5 animal unit month per acre on the Enning soil and 0.6 animal unit month per acre on the Minnequa soil. The stocking rate is determined by the percentage of each soil in the pasture. The range should be closely monitored during use and the stocking rates adjusted so that one soil does not become overgrazed. A planned grazing system that includes proper grazing use and timely deferments from grazing helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Brush management may be needed in some areas to control the woody plants that invade the site.

Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range. In areas where gullies have formed because of severe water erosion, land shaping or other mechanical practices may be needed to smooth and stabilize the site before it is reseeded.

The Enning soil is generally not suited to the trees and shrubs planted in windbreaks. The shallow depth to bedrock and the steep slope severely limit the planting, survival, or growth of trees and shrubs. Onsite investigation may identify small areas that are suitable for windbreaks. The Minnequa soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and water erosion are the principal hazards affecting seedlings and young trees. Seedlings can survive and grow if competing vegetation is controlled or removed by good site preparation, timely cultivation between the tree rows, or by careful use of the appropriate kind of herbicide. Planting the trees on the contour and terracing help to control water erosion and excessive runoff. Irrigation can provide supplemental moisture during periods of low rainfall.

The Enning soil is generally not suitable for septic tank absorption fields because it is shallow to bedrock. A suitable alternative site should be selected. In areas of the moderately deep Minnequa soil, building up or mounding the sites for septic tank absorption fields with suitable fill material improves the filtering capacity of the soil. Buildings should be designed so that they conform to the natural slope of the land, or the soil and soft bedrock can be graded to a suitable gradient. Strengthening the foundations of buildings and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. The soft bedrock can be excavated during the construction of roads in areas of the Enning soil. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of these soils. Coarser grained material can be used to ensure better performance. Cutting and filling can provide a suitable grade for roads.

The land capability unit is VIs-4, dryland, for the Enning soil and VIe-9, dryland, for the Minnequa soil. The Enning soil is in the Shallow Limy range site and windbreak suitability group 10. The Minnequa soil is in the Limy Upland range site and windbreak suitability group 3.

EvG—Enning-Rock outcrop complex, 9 to 40 percent slopes. This map unit consists of the shallow, well drained, strongly sloping to very steep Enning soil and areas of eroded exposures of interbedded chalk and shale on uplands. The Enning soil formed in silty, calcareous material weathered from chalky shale and limestone. It is on strongly sloping side slopes and ridgetops. The areas of Rock outcrop are on the steep and very steep side slopes and ridgetops, on the steep side slopes of buttes, ridges, and escarpments, or on eroded side slopes along intermittent drainageways. Areas range from 20 to 300 acres in size. They consist of 30 to 50 percent Enning soil and

30 to 60 percent areas of Rock outcrop. These areas are so intermingled or mixed that separating them in mapping is not practical.

Typically, the surface layer of the Enning soil is light yellowish brown, friable, calcareous silty clay loam about 3 inches thick. The underlying material is brownish yellow, firm, calcareous silty clay loam to a depth of 18 inches. Below this to a depth of more than 60 inches is white, chalky shale.

Typically, the areas of Rock outcrop consist of eroded exposures of interbedded chalk and shale. In some places silt loam or silty clay loam that is less than 10 inches thick is on the chalk and shale.

Included with this unit in mapping are small areas of Manvel and Minnequa soils. Manvel soils are very deep and are on foot slopes and alluvial fans. Minnequa soils are moderately deep over interbedded chalk and shale and are on the lower slopes. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Enning soil, and available water capacity is very low. The organic matter content is moderately low. Runoff is very rapid.

All of the acreage in this map unit is used as range. It is not suited to cropland because of the rugged terrain, the shallow soils, and the areas of shale outcrop.

If this map unit is used as range, the climax vegetation on the Enning soil is dominantly little bluestem, sideoats grama, blue grama, and threadleaf sedge. These species make up 70 percent or more of the total annual forage. Prairie sandreed, western wheatgrass, hairy grama, sand bluestem, big bluestem, needleandthread, green needlegrass, and forbs make up the rest. If subject to continuous heavy grazing, little bluestem, sand bluestem, and big bluestem decrease in abundance and are replaced by sideoats grama, blue grama, hairy grama, prairie sandreed, sand dropseed, threadleaf sedge, and forbs. If overgrazing continues for many years, woody plants may invade the site.

If the range is in excellent condition, the suggested initial stocking rate on the Enning soil is 0.5 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. The slope can hinder the movement of livestock. Brush management may be needed in some areas to control the woody plants that invade the site.

The Enning soil is generally not suited to the trees and shrubs planted in windbreaks. A few areas can be used for the trees and shrubs that enhance recreational areas or wildlife habitat if they are planted by hand or if other special management is used.

The Enning soil is not suited to septic tank absorption fields because of the steep slope, the shallow depth to bedrock, and the areas of shale outcrop. The excessive slope generally is too severe a limitation to overcome for building site development. Cutting and filling are needed to provide a suitable grade for roads.

The land capability unit is VIIs-4, dryland, for the Enning soil and VIIIs-8, dryland, for the areas of Rock outcrop. The Enning soil is in the Shallow Limy range site. No range site is assigned to the areas of Rock outcrop. The Enning soil and the areas of Rock outcrop are in windbreak suitability group 10.

EwG—Epping-Badland complex, 3 to 60 percent slopes. This map unit consists of the shallow, gently sloping to very steep, well drained Epping soil and areas of Badland. The Epping soil formed in material weathered from siltstone. Badland is the eroded, barren exposures of siltstone and shale that support little or no vegetation. The Epping soil is on ridgetops and side slopes. Badland is along the deeply dissected drainageways and gullies that form at close intervals. Areas range from 20 to 400 acres in size. They consist of 40 to 65 percent Epping soil and 25 to 50 percent Badland. These areas are so intermingled or mixed that separating them in mapping is not practical.

Typically, the Epping soil has a surface layer of pale brown, very friable, calcareous very fine sandy loam about 4 inches thick. The transitional layer is pale brown, very friable, calcareous very fine sandy loam about 4 inches thick. The underlying material is very pale brown, very friable, calcareous very fine sandy loam to a depth of 15 inches. Below this to a depth of more than 60 inches is very pale brown, calcareous siltstone. In some areas siltstone is within a depth of 10 inches. In some areas lime is below a depth of 6 inches. In some places the surface layer is silt loam or loam.

Badland is the eroded, nearly barren exposures of siltstone and shale.

Included with this unit in mapping are small areas of Thirtynine and Mitchell soils. Thirtynine soils have more clay in the subsoil than the Epping soil and siltstone below a depth of 40 inches. They are lower on the landscape than the Epping soil and the Badland. Mitchell soils are very deep and are on foot slopes below areas of the Epping soil and the Badland. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Epping soil, and available water capacity is very low. The organic matter content is low. Runoff is medium and rapid on the Epping soil and very rapid in areas of the Badland.

All of the acreage in this map unit is used for range. It is not suited to cultivation because of the rugged terrain, the shallow soils, and the areas of rock outcrop.

If this map unit is used as range, the climax vegetation on the Epping soil is dominantly little bluestem, sideoats grama, western wheatgrass, blue grama, and threadleaf sedge. The species make up 60 percent or more of the total annual forage. Prairie sandreed, hairy grama, sand bluestem, big bluestem, needleandthread, green needlegrass, and forbs make up the rest. If subject to continuous heavy grazing, little bluestem, sand bluestem, and big bluestem decrease in abundance and are replaced by sideoats grama, blue grama, hairy grama, prairie sandreed, sand dropseed, threadleaf sedge, and forbs. If overgrazing continues for many years, woody plants may invade the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.5 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. The slope can hinder the movement of livestock. Brush management may be needed in some areas to control the woody plants that invade the site.

The Epping soil generally is not suited to the trees and shrubs planted in windbreaks. The very steep and shallow soils severely limit the planting, survival, and growth of trees and shrubs. Onsite investigation may identify small areas that are suitable for planting the trees and shrubs that enhance recreational areas or wildlife habitat if they are planted by hand or if other special management is used.

The Epping soil is not suited to septic tank absorption fields because of the shallow depth to bedrock and the steep slope. A suitable alternative site should be selected. The excessive slope generally is too severe a limitation to overcome for building site development. Cutting and filling are needed to provide a suitable grade for roads.

The land capability unit is VIIs-4, dryland, for the Epping soil and VIIIs-8, dryland, for the Badland. The Epping soil is in the Shallow Limy range site. No range site is assigned to the Badland. The Epping soil and the Badland are both in windbreak suitability group 10.

Fu—Fluvaquents, sandy, 0 to 1 percent slopes. This very deep, nearly level, very poorly drained soil is on bottom land. It formed in sandy alluvium. This soil is in oxbows and the low lying areas bordering the larger streams. It is subject to frequent flooding for brief to very long periods from stream overflow and is ponded for long periods by a very high water table. Individual areas range from 5 to 20 acres in size.

Typically, the surface layer is dark grayish brown loamy sand about 3 inches thick. The underlying material to a depth of more than 60 inches is light gray fine sand and sand stratified with lighter and darker strata of loamy sand to loam. In some places a layer of decaying leaves and stems is on the surface. In other places the surface layer is loam.

Included with this soil in mapping are small areas of Almeria, Bolent, and Las Animas soils. The included soils are better drained than the Fluvaquents and are slightly higher on the landscape. Also included are small areas of water in low areas and in former stream channels and oxbows. Included areas make up 5 to 15 percent of the unit.

Permeability is rapid in the Fluvaquents. Available water capacity is low. Organic matter content is moderate or high. Runoff is very slow to ponded. The seasonal high water table ranges from 2 feet above the surface during wet years to about 1 foot below the surface during dry years. This soil has water above the surface for long periods during most years. During extended dry periods the water table normally recedes below the surface.

This soil is used mainly as wildlife habitat. Areas of this soil are too wet for cultivated cropland, hayland, or range. The vegetation is coarse and nonpalatable for livestock. Vegetation consists mainly of cattails, rushes, arrowheads, willows, and other water tolerant plants.

This soil is not suitable for the trees and shrubs planted in windbreaks because of the wetness. A few marginal areas may be suitable for the trees or shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

This soil is not suited to use as septic tank absorption fields and building sites because of the frequent flooding. A suitable alternative site should be selected. The excavations should be made only during extremely dry periods. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate side ditches, and installing culverts help protect roads from the damage caused by

flooding and the wetness caused by the seasonal high water table.

The land capability unit is VIIIw-7, dryland, and windbreak suitability group 10. No range site is assigned.

Gg—Gannett loam, 0 to 1 percent slopes. This very deep, nearly level, poorly drained soil is in sandhill valleys. It formed in loamy and sandy alluvium. This soil is subject to rare flooding. Individual areas range from 20 to 100 acres in size.

Typically, the surface layer is dark gray, friable loam about 16 inches thick. The subsurface layer is very dark gray, friable loam about 7 inches thick. The underlying material is light gray, mottled fine sand to a depth of more than 60 inches. In places the underlying material has strata of fine sandy loam and loamy fine sand. In some areas the surface layer is fine sandy loam or sandy loam. In some places this soil is very poorly drained.

Included with this soil in mapping are small areas of Els, calcareous; Elsmere; Ipage; Marlake; and Tryon soils. The included soils have more sand in the upper part of the profile than the Gannett soil. Els, calcareous; Elsmere; and Ipage soils are higher on the landscape than the Gannett soil. Marlake soils are lower on the landscape than the Gannett soil and have water above the surface for most of the growing season. Tryon soils are on similar landscapes as the Gannett soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the solum in the Gannett soil and rapid in the underlying material. Available water capacity is moderate. The organic matter content is high. Runoff is very slow. The seasonal high water table ranges from the surface during wet years to a depth of 1.5 feet during dry years.

All of the acreage of this soil is used as range or hayland. It is too wet for use as cropland.

If this soil is used as range or hayland, the climax vegetation is dominantly big bluestem, indiangrass, prairie cordgrass, and switchgrass. These species make up 65 percent or more of the total annual forage. Bluegrass, slender wheatgrass, sedges, rushes, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, big bluestem, prairie cordgrass, switchgrass, and indiangrass decrease in abundance and are replaced by slender wheatgrass, western wheatgrass, plains muhly, and sedges. If overgrazing or improper haying continues for many years, bluegrass, western wheatgrass, sedges, rushes, and forbs dominate the site.

If the range is in excellent condition the suggested initial stocking rate is 1.8 animal unit months per acre. A planned grazing system that includes proper grazing use, timely deferments from grazing and haying, and restricted use during very wet periods helps to maintain and improve the range condition. Areas of this soil are generally the first to be overgrazed in a pasture that includes the better drained, sandy soils. Properly located fences and livestock watering and salting facilities result in a more uniform distribution of grazing. During wet periods, grazing and operating heavy machinery cause surface compaction and the formation of small mounds and ruts, which make grazing or harvesting hay difficult.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. Large meadows can be divided into three sections and the sections mowed in rotation. The order in which the sections are mowed should be changed in successive years. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in the spring before the ground thaws and the water table reaches a high level.

This soil is suited to the trees and shrubs planted in windbreaks. The main limitation affecting the establishment of windbreaks is the wetness caused by the high water table. The species selected for planting should be those that withstand the occasional wetness. Tilling and planting seedlings should be delayed until after the soil has begun to dry. The weeds and undesirable grasses can be controlled by cultivation between the tree rows with conventional equipment and by the use of the appropriate kind of herbicide in the tree rows.

This soil is not suited to septic tank absorption fields and building sites because of the wetness and the flooding. A suitable alternative site should be selected. The sides of shallow excavations can cave in unless they are shored. The excavations should be made during dry periods. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate side ditches, and installing culverts help protect roads from the damage caused by flooding and the wetness. A good surface drainage system and a gravel moisture barrier in the subgrade can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

The land capability unit is Vw-7, dryland; Wet Subirrigated range site; and windbreak suitability group 2D.

Gh—Gannett loam, wet, 0 to 1 percent slopes. This very deep, nearly level, very poorly drained soil is in sandhill valleys. It formed in loamy and sandy alluvium. It is occasionally ponded by water from the seasonal high water table. This soil is subject to rare flooding. Areas range from 20 to 50 acres.

Typically, the surface layer is dark gray, very friable loam about 19 inches thick. The subsurface layer is gray, friable loam about 10 inches thick. The underlying material is light gray, mottled fine sand to a depth of 60 inches or more. In some areas the surface layer is fine sandy loam. In places the underlying material has strata of fine sandy loam and loamy fine sand. In a few areas this soil is poorly drained.

Included with this soil in mapping are small areas of Els, Elsmere, Ipage, Marlake, and Tryon soils. The included soils have more sand in the profile than the Gannett soil. Els, Elsmere, and Ipage soils are better drained than the Gannett soil and are higher on the landscape. Marlake and Tryon soils are very poorly drained and are lower on the landscape than the Gannett soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the solum in the Gannett soil and rapid in the underlying material. Available water capacity is moderate. The organic matter content is high. Runoff is very slow or ponded. The seasonal high water table ranges from about 0.5 foot above the surface during wet years to a depth of about 1.0 foot during dry years.

All of the acreage of this soil is used as range or hayland. This soil is not suitable for farming.

If this soil is used as range or hayland, the climax vegetation is dominantly prairie cordgrass, bluejoint reedgrass, and northern reedgrass. These species make up 55 percent or more of the total annual production. Bluegrass, slender wheatgrass, green muhly, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, prairie cordgrass, bluejoint reedgrass, and northern reedgrass decrease in abundance and are replaced by slender wheatgrass, bluegrass, green muhly, sedges, rushes, and forbs. If overgrazing or improper haying continues for many years, bluegrass, foxtail barley, sedges, rushes, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 2.0 animal unit months per acre. This soil produces a high quantity of low-quality forage. A planned grazing system that includes proper grazing use, timely deferments from grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. During wet periods, grazing and operating heavy machinery can cause surface compaction and the formation of mounds and ruts, which make grazing or harvesting hay difficult.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. In wet years, some areas of hay cannot be harvested. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in the spring before the ground thaws.

This soil is not suited to the trees and shrubs planted in windbreaks because of the wetness caused by the high water table. A few marginal areas may be suitable for the trees or shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

This soil is not suited to septic tank absorption fields or building sites because of the wetness caused by the seasonal high water table and the hazard of flooding. A suitable alternative site should be selected. The sides of shallow excavations can cave in unless they are shored. The excavations should be made during dry periods. Constructing roads on suitable, well compacted fill material above the level of ponding, providing adequate side ditches, and installing culverts help protect roads from the damage caused by ponding and the wetness caused by the seasonal high water table and the rare flooding. A good surface drainage system and a gravel moisture barrier in the subgrade can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

The land capability unit is Vw-7, dryland; Wetland range site; and windbreak suitability group 10.

Hm—Hoffland fine sandy loam, 0 to 1 percent slopes. This very deep, nearly level, poorly drained soil is in sandhill valleys. It formed in sandy alluvium. This soil is subject to rare flooding. Areas range from 20 to 100 acres.

Typically, the surface layer is gray, friable, calcareous fine sandy loam about 4 inches thick. The subsurface layer is friable, calcareous fine sandy loam about 7 inches thick. It is grayish brown in the upper part and gray in the lower part. The underlying material is mottled, light gray fine sand to a depth of more than 60 inches. In some places the surface layer is loam. In places the underlying material is calcareous. In a few places the soil is very poorly drained. In some areas the solum is more than 20 inches thick.

Included with this soil in mapping are small areas of Els, Ipage, and Wildhorse soils. The included soils are better drained than the Hoffland soil and are higher on

the landscape. Wildhorse soils have a high content of sodium. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Hoffland soil, and available water capacity is low. The organic matter content is very high. Runoff is very slow. The soil has a seasonal high water table that ranges from the surface during wet years to a depth of 1.5 feet during dry years.

Nearly all of the acreage of this soil is used as range. Most of the grasses are mowed for hay, but a few areas are grazed. This soil is not suitable for farming because of the wetness caused by the seasonal high water table.

If this soil is used as range or hayland, the climax vegetation is dominantly big bluestem, indiangrass, prairie cordgrass, and switchgrass. These species make up 60 percent or more of the total annual forage. Bluegrass, slender wheatgrass, sedges, rushes, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, big bluestem, prairie cordgrass, switchgrass, and indiangrass decrease in abundance and are replaced by slender wheatgrass, western wheatgrass, plains muhly, and sedges. If overgrazing or improper haying continues for many years, bluegrass, western wheatgrass, sedges, rushes, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 1.8 animal unit months per acre. A planned grazing system that includes proper grazing use, timely deferments from grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. Areas of this soil are generally the first to be overgrazed in a pasture that includes the better drained, sandy soils. Properly located fences and livestock watering and salting facilities result in a more uniform distribution of grazing. During wet periods, grazing and operating heavy machinery cause surface compaction and the formation of small mounds and ruts, which make grazing or harvesting hay difficult.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. Large meadows can be divided into three sections and the sections mowed in rotation. The order in which the sections are mowed should be changed in successive years. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in the spring before the ground thaws and the water table reaches a high level.

This soil is suited to the trees and shrubs planted in windbreaks. The primary limitation affecting the establishment of windbreaks is the wetness caused by the high water table. The species selected for planting should be those that can withstand the occasional wetness. Tilling and planting seedlings should be delayed until after the soil has begun to dry. The weeds and undesirable grasses can be controlled by cultivation between the tree rows with conventional equipment and by the use of the appropriate kind of herbicide in the tree rows.

This soil is generally not suited to septic tank absorption fields because of the wetness caused by the seasonal high water table and the flooding. A suitable alternative site should be selected. This soil is not suited to building sites because of the flooding and the wetness. A suitable alternative site should be selected. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving if the excavations are made during dry periods. Constructing roads on suitable, well compacted fill material, providing adequate side ditches, and installing culverts help protect roads from the wetness and the damage caused by flooding.

The land capability unit is Vw-7, dryland; Wet Subirrigated range site; and windbreak suitability group 2D.

Hn—Hoffland fine sandy loam, wet, 0 to 1 percent slopes. This very deep, nearly level, very poorly drained soil is in sandhill valleys. It formed in sandy alluvium. This soil is occasionally ponded by water from the seasonal high water table. This soil is subject to rare flooding. Areas range from 30 to 50 acres in size.

Typically, the surface layer is gray, friable, calcareous fine sandy loam about 8 inches thick. The transitional layer is light gray, mottled, friable, calcareous fine sandy loam 6 inches thick. The underlying material is light gray and grayish brown, mottled, calcareous fine sand and loamy fine sand to a depth of about 27 inches. Below this to a depth of 60 inches is light gray fine sand. In some areas the surface layer is less than 6 inches thick. In a few places the loamy material is more than 2 feet thick over the sandy material. In some areas the surface layer is loam. In some places the underlying material is stratified with thin layers of loam and fine sandy loam.

Included with this soil in mapping are small areas of Els, Wildhorse, and Marlake soils. Els and Wildhorse soils are better drained than the Hoffland soil and are higher on the landscape. Wildhorse soils have a high content of sodium. Marlake soils are lower on the landscape than the Hoffland soil and have water above the surface for most of the growing season. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Hoffland soil. Available

water capacity is low. The organic matter content is very high. Runoff is very slow or ponded. The seasonal high water table ranges from about 0.5 foot above the surface during wet years to a depth of about 1.0 foot during dry years. It generally recedes to a depth of 2 feet or more in late summer.

All of the acreage of this soil is used as range. Most of the grasses are mowed for hay, but a few areas are grazed. This soil is not suited to farming because of the wetness caused by the seasonal high water table.

If this soil is used as range, either for grazing or hay, the climax vegetation is dominantly prairie cordgrass, northern reedgrass, bluejoint reedgrass, slender wheatgrass, and various sedges. These species make up 75 percent or more of the total annual forage. Rushes and other perennial grasses and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, prairie cordgrass, bluejoint reedgrass, and northern reedgrass decrease in abundance. Initially, these species are replaced by slender wheatgrass, plains bluegrass, green muhly, and various sedges, rushes, and forbs. If overgrazing or improper haying continues for many years, plains bluegrass, foxtail barley, and various sedges, rushes, and forbs dominate the site. During wet periods, continuous heavy grazing or operating heavy machinery causes surface compaction and the formation of small mounds and ruts, which make grazing or harvesting hay difficult.

If the range is in excellent condition, the suggested initial stocking rate is 2.0 animal unit months per acre. This soil produces high yields, but the forage is of low quality. The forage is of higher quality early in the growing season. A planned grazing system that includes proper grazing use, timely deferments from grazing and haying, and restricted use during very wet periods helps to maintain or improve the range condition.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. In some years hay cannot be harvested because of the excessive wetness. Large meadows can be divided into three sections and mowed in rotation. The order in which the sections are mowed should be changed in successive years. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in the spring before the ground thaws and the water table reaches a high level.

This soil is not suited to the trees or shrubs planted in windbreaks because of the wetness caused by the seasonal high water table. A few marginal areas may be suitable for the trees or shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

This soil is not suited to sanitary facilities or building sites because of the wetness caused by the seasonal high water table and the hazard of flooding. A suitable alternative site should be selected. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving if the excavations are made during dry periods. Constructing roads on suitable, well compacted fill material above the level of ponding, providing adequate side ditches, and installing culverts help protect roads from the wetness and the damage caused by ponding.

The land capability unit is Vw-7, dryland; Wetland range site; and windbreak suitability group 10.

IpB—Ipage fine sand, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, moderately well drained soil is in sandhill valleys. It formed in eolian sand. Individual areas range from 10 to about 200 acres in size.

Typically, the surface layer is dark grayish brown, loose fine sand about 5 inches thick. The transitional layer is grayish brown, loose fine sand about 6 inches thick. The underlying material is light brownish gray and pale brown fine sand to a depth of more than 60 inches. The lower part is mottled. In some areas the dark surface soil is more than 10 inches thick. In some places the surface layer is sand, loamy fine sand, or loamy sand. In other places carbonates are at a depth of less than 20 inches.

Included with this soil in mapping are small areas of Els, calcareous; Hoffland; Valent; Valentine; and Wildhorse soils. Els, calcareous, and Wildhorse soils are lower on the landscape than the Ipage soil and are somewhat poorly drained. Also, Wildhorse soils have a high content of sodium. Hoffland soils are poorly drained and are lower on the landscape than the Ipage soil. Valent and Valentine soils are excessively drained and are on dunes. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Ipage soil, and available water capacity is low. The organic matter content is low. Runoff is slow. This soil has a seasonal high water table that ranges from a depth of 3 feet during wet years to 5 feet during dry years. The water intake rate is very high.

Most of the acreage of this soil is used as range. A few small areas are used for irrigated crops.

This soil is not suited to dryland crops because of droughtiness and the hazard of soil blowing.

If irrigated by a sprinkler system, this soil is poorly suited to corn, alfalfa, and introduced grasses. This

soil is too sandy for gravity irrigation. Soil blowing is a hazard if the surface is unprotected. Stripcropping, stubble mulching, and cover crops help to control soil blowing and conserve soil moisture. This soil is droughty because of the low available water capacity, and light, frequent applications of irrigation water are needed. Excessive amounts of water can leach essential plant nutrients below the root zone. Returning crop residue, green manure crops, and feedlot manure to the soil helps improve the organic matter content and fertility.

If this soil is used as range or hayland, the climax vegetation is dominantly sand bluestem, little bluestem, prairie sandreed, switchgrass, and needleandthread. These species make up 75 percent or more of the total annual forage. Blue grama, prairie junegrass, bluegrass, indiangrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, indiangrass, little bluestem, and switchgrass decrease in abundance and are replaced by prairie sandreed, needleandthread, sand dropseed, blue grama, sedges, and forbs. If overgrazing continues for many years, blue grama, sand dropseed, needleandthread, Scribner panicum, sedges, and forbs dominate the site. Under these conditions, the native plants lose vigor and are unable to stabilize the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, mowing should be regulated so that the grasses remain healthy and vigorous. The forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range.

This soil is suited to the trees and shrubs planted in windbreaks. Soil blowing is a severe hazard affecting the establishment of windbreaks. It can be controlled by planting the seedlings in shallow furrows with as little disturbance of the soil as possible. Maintaining strips of sod or cover crops between the tree rows also helps to control soil blowing. Insufficient rainfall in summer is also a hazard affecting the survival of young trees. Irrigation can provide supplemental moisture during periods of low rainfall. The weeds and undesirable grasses in the tree rows can be controlled by careful use of the appropriate kind of herbicide or by hoeing by hand.

Constructing septic tank absorption fields on fill material raises the fields a sufficient distance above the seasonal high water table. Seepage from the septic tank can result in pollution of the ground water. This soil is generally suited to sites for dwellings and buildings without basements. Buildings with basements should be constructed on raised, well compacted fill material to overcome the wetness caused by the high water table. A good surface drainage system and a gravel moisture barrier in the subgrade can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

The land capability units are VIe-5, dryland, and IVe-12, irrigated; Sandy Lowland range site; and windbreak suitability group 7.

JgB—Jayem fine sandy loam, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, well drained soil is on uplands. It formed in loamy and sandy eolian material weathered from sandstone. Areas range from 5 to 600 acres in size.

Typically, the surface layer is grayish brown, very friable fine sandy loam about 8 inches thick. The subsurface layer is about 8 inches thick. It is similar to the surface layer in color and texture. The subsoil is light brownish gray and light gray, very friable fine sandy loam about 16 inches thick. The underlying material is light gray very fine sandy loam and loamy very fine sand to a depth of more than 60 inches. In some places carbonates are within a depth of 40 inches. In places the dark surface layer is more than 20 inches thick. In some places the surface layer is loamy fine sand.

Included with this soil in mapping are small areas of Dailey, Satanta, and Tuthill soils. Dailey soils have more sand throughout the profile than the Jayem soil and are on similar landscapes. Satanta and Tuthill soils have more clay in the subsoil than the Jayem soil and are on similar landscapes. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Jayem soil, and available water capacity is moderate. The organic matter content is moderately low. Runoff is slow. The water intake rate is moderately high.

Most of the acreage of this soil is used as dryland or irrigated cropland. Some areas are used for range.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in

summer generally limits the cultivated crops that can be successfully grown. Soil blowing is the principal hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to control soil blowing. Because of the moderate available water capacity, these tillage practices also help to conserve soil moisture. Cover crops also help to control erosion. Returning crop residue to the soil helps improve the organic matter content and the water intake rate.

If irrigated, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. This soil is best suited to sprinkler irrigation because of the moderately high water intake rate. Some land leveling is generally needed if gravity systems are used so that the movement and intake rate of water are uniform. Soil blowing is the principal hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue and green manure crops into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with other crops. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or trefoil, or warm-season grasses, such as switchgrass or big bluestem, into pasture and hayland. Continuous heavy grazing reduces the amount of protective cover and the quality of the stands, resulting in a severe hazard of soil blowing. Managing separate pastures of cool- and warm-season grasses can extend the grazing season. Rotation grazing and proper stocking rates help keep the grasses in good condition. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be applied by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. As a result, soil blowing is excessive and small blowouts can form. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants.

This soil is suited to the trees and shrubs planted in windbreaks. Soil blowing is the main hazard affecting the establishment of windbreaks. It can be controlled by maintaining strips of sod or a cover crop between the tree rows. The weeds and undesirable grasses in the tree rows can be controlled by careful use of the appropriate kind of herbicide or by hoeing by hand. Cultivation between the tree rows with conventional equipment can control undesirable grasses and weeds in areas where strips of sod and cover crops are not used. The lack of adequate rainfall in summer is also a hazard affecting the survival of young trees. Irrigation can provide supplemental moisture during periods of low rainfall.

This soil is generally suitable for septic tank absorption fields, building sites, and roads. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

The land capability units are IIIe-3, dryland, and IIe-8, irrigated; Sandy range site; and windbreak suitability group 5.

JgC—Jayem fine sandy loam, 3 to 6 percent slopes. This very deep, gently sloping, well drained soil is on side slopes on uplands. It formed in loamy and sandy eolian material weathered from sandstone. Areas range from 5 to 240 acres in size.

Typically, the surface layer is grayish brown, very friable fine sandy loam about 7 inches thick. The subsurface layer is grayish brown, very friable fine sandy loam about 4 inches thick. The subsoil is light brownish gray, very friable fine sandy loam about 13 inches thick. The underlying material is light gray fine sandy loam to a depth of more than 60 inches. In some places the dark surface layer is more than 20 inches thick. In other places the dark surface layer is less than 7 inches thick. In some areas the underlying material is loamy fine sand and is within a depth of 40 inches. In some cultivated areas the surface layer is loamy fine sand. In places the underlying material is calcareous within a depth of 40 inches.

Included with this soil in mapping are small areas of Dailey, Satanta, and Tuthill soils. Dailey soils have more sand throughout the profile than the Jayem soil and are slightly higher on the landscape. Satanta and Tuthill soils have more clay in the subsoil than the Jayem soil and are on similar landscapes. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Jayem soil, and available water capacity is moderate. The organic matter content is moderately low. Runoff is slow and

medium. The water intake rate is moderately high. The surface layer is very friable and is easily tilled throughout a wide range in moisture content.

About half of the acreage of this soil is used as cropland. Some areas are irrigated. The rest is used for range.

If dryland farmed, this soil is poorly suited to small grains, alfalfa, and introduced grasses. Inadequate rainfall in summer generally limits the cultivated crops that can be grown. Water erosion and soil blowing are the principal hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to control soil blowing and water erosion. Because of the moderate available water capacity, these tillage practices also help to conserve soil moisture. Stripcropping, terraces, and annual cover crops help to control soil blowing and water erosion. Summer fallowing conserves moisture for use during the following growing season.

If irrigated, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. This soil is best suited to sprinkler irrigation because of the slope and the moderately high water intake rate. Extensive land leveling is needed if gravity systems are used. Soil blowing and water erosion are the principal hazards. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue and green manure crops into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients and result in the hazard of water erosion on the slopes.

This soil is poorly suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. This soil is subject to water erosion. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Continuous heavy grazing and improper haying also reduce the amount of protective cover and can result in soil blowing and the formation of small gullies and rills after heavy rains. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing and water erosion. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. As a result, soil blowing is excessive. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants. Range seeding may be needed to stabilize severely eroded areas of cropland.

This soil is suited to the trees and shrubs planted in windbreaks. Soil blowing and water erosion are the main hazards affecting the establishment of windbreaks. Erosion can be controlled by maintaining strips of sod or a cover crop between the tree rows. Planting on the contour helps to control water erosion. The weeds and undesirable grasses in the tree rows can be controlled by careful use of the appropriate kind of herbicide or by hoeing by hand. Cultivation between the rows with conventional equipment can control undesirable grasses and weeds in areas where strips of sod and cover crops are not used. The lack of adequate rainfall in summer is also a hazard affecting the survival of young trees. Irrigation can provide supplemental moisture during periods of low rainfall.

This soil is generally suitable for septic tank absorption fields and roads. The sides of shallow excavations can cave unless they are shored. Buildings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient.

The land capability units are IVe-3, dryland, and IIIe-8, irrigated; Sandy range site; and windbreak suitability group 5.

JgD—Jayem fine sandy loam, 6 to 9 percent slopes. This very deep, strongly sloping, well drained soil is on uplands. It formed in loamy and sandy eolian material weathered from sandstone. Individual areas range from 5 to 240 acres in size.

Typically, the surface layer is grayish brown, very friable fine sandy loam about 8 inches thick. The subsurface layer is about 5 inches thick. It is similar to the surface layer in color and texture. The subsoil is brown, very friable fine sandy loam about 8 inches thick. The underlying material to a depth of more than

60 inches is grayish brown fine sandy loam in the upper part and light brownish gray loamy fine sand in the lower part. In some cultivated areas the surface layer is loamy fine sand. In places the underlying material is calcareous within a depth of 40 inches.

Included with this soil in mapping are small areas of Busher, Dailey, and Satanta soils. Busher and Dailey soils are on similar landscapes as the Jayem soil. Busher soils have weakly cemented, limy sandstone at a depth of 40 to 60 inches. Dailey soils have more sand throughout the profile. Satanta soils have more clay in the subsoil than the Jayem soil and are lower on the landscape. Included soils make up 10 to 15 percent of the unit.

Permeability is moderately rapid in the Jayem soil, and available water capacity is moderate. The organic matter content is moderately low. Runoff is medium. The water intake rate is moderately high.

Most of the acreage of this soil is used as range. Some areas are cultivated.

If dryland farmed, this soil is poorly suited to small grains, alfalfa, and introduced grasses. Inadequate rainfall in summer generally limits the crops that can be successfully grown. Soil blowing and water erosion are hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and stripcropping, helps to control soil blowing and water erosion and conserve soil moisture. Because of the moderate available water capacity, these tillage practices also help to conserve the available soil moisture. Incorporating crop residue and manure into the soil helps improve the organic matter content and fertility.

If irrigated by a sprinkler system, this soil is poorly suited to corn, small grains, alfalfa, and introduced grasses. This soil is not suited to gravity irrigation systems because of the slope. Soil blowing and water erosion are hazards in areas where the surface is not protected by crops or crop residue. A system of conservation tillage, such as no-till, keeps crop residue on the surface, helps to control erosion, and conserves soil moisture. Cover crops also help to control erosion. Returning crop residue, green manure crops, and manure to the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can result in the hazard of water erosion on the slopes and leach plant nutrients below the root zone.

If this soil is used for range or native hay, the climax vegetation is dominantly prairie sandreed, sand bluestem, needleandthread, and little bluestem. These species make up 65 percent or more of the total annual forage. Blue grama, switchgrass, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, prairie sandreed, blue grama, Scribner panicum, sand dropseed, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

This soil is suited to the trees and shrubs planted in windbreaks. Soil blowing and water erosion are the main hazards affecting the establishment of windbreaks. Erosion can be controlled by maintaining strips of sod or cover crops between the tree rows. Planting trees on the contour helps to control water erosion. Irrigation can provide supplemental moisture during periods of low rainfall. The weeds and undesirable grasses in the tree rows can be controlled by careful use of the appropriate kind of herbicide or by hoeing by hand.

This soil is generally suited to septic tank absorption fields and sites for roads and streets. Dwellings and buildings should be properly designed so that they conform to the natural slope of the land, or the soil can be graded to an acceptable gradient. The sides of shallow excavations can cave in unless they are shored.

The land capability units are IVe-3, dryland, and IVe-8, irrigated; Sandy range site; and windbreak suitability group 5.

Jo—Johnstown loam, 0 to 1 percent slopes. This very deep, nearly level, well drained soil is on uplands. It formed in loess and loamy sediment deposited over gravelly sand. Areas range from 5 to 320 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 7 inches thick. The subsurface layer is dark grayish brown, friable loam about 4 inches thick. The subsoil is about 26 inches thick. The upper part is grayish brown, firm silty clay loam over a buried soil that is dark grayish brown, firm silty clay loam in the upper part and pale brown, firm silty clay loam in the lower part. The lower part of the subsoil is light

gray, friable, calcareous loam. The underlying material to a depth of more than 60 inches is light gray, calcareous loam in the upper part and light gray, calcareous gravelly coarse sand in the lower part. In some places the surface layer is silt loam, fine sandy loam, or clay loam. In some areas the dark surface soil is less than 20 inches thick. In some places the gravelly layer is at a depth of more than 60 inches. In places the gravelly layer is within a depth of 40 inches because of land leveling.

Included with this soil in mapping are small areas of Bridget soils, which are calcareous and contain less clay in the profile than the Johnstown soil. These soils are on similar landscapes. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the solum in the Johnstown soil and rapid and very rapid in the underlying material. Available water capacity is moderate. The organic matter content is moderate. Runoff is slow. The water intake rate is moderately low.

Most of the acreage of this soil is used for irrigated crops. The rest is used mainly for dryland crops.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Soil blowing is a slight hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, help to conserve soil moisture and control soil blowing. Returning crop residue to the soil helps to maintain the organic matter content and improve the water intake rate.

If irrigated, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. It is suited to sprinkler and gravity irrigation systems (fig. 11). Some land leveling is needed if gravity systems are used so that the distribution of water is uniform. Soil blowing is a slight hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue into the soil helps to maintain the organic matter content and fertility. Irrigation systems should be designed so that the water application rate does not exceed the moderately low water intake rate. A tailwater recovery system can be used to conserve water.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of native plants. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall is the principal hazard. Seedlings can survive and grow if competing vegetation is controlled or removed by cultivation or by the careful use of the appropriate kind of herbicide. Irrigation can provide supplemental moisture during periods of low rainfall.

This soil is generally suited to sites for dwellings and buildings with basements. Because of the rapid and very rapid permeability of the gravelly underlying material, this soil does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. Mounding the site with several feet of suitable fill material improves the filtering capacity of the soil. The moderate permeability of the solum is also a limitation affecting septic tank absorption fields. Strengthening the foundations for dwellings and buildings without basements and backfilling with coarse textured material help to prevent the damage caused by the shrinking and swelling of the soil. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained subgrade or base material can be used to ensure better performance.

The land capability units are IIc-1, dryland, and I-4, irrigated; Silty range site; and windbreak suitability group 3.

Figure 11.—A gravity irrigation system in a field of dry, edible beans on Johnstown loam, 0 to 1 percent slopes.

Kd—Kadoka silt loam, 0 to 2 percent slopes. This moderately deep, nearly level, well drained soil is on uplands. It formed in silty material weathered from siltstone. Areas range from 10 to 200 acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 7 inches thick. The subsoil is about 13 inches thick. The upper part is grayish brown, friable silty clay loam, and the lower part is pale brown, friable calcareous loam. The underlying material is very pale brown, calcareous loam about 9 inches thick. Siltstone is below a depth of 29 inches. In some places siltstone is below a depth of 40 inches. In other places the surface layer is loam.

Included with this soil in mapping are small areas of Bridget, Epping, and Thirtynine soils. Bridget and Thirtynine soils do not have bedrock within a depth of 60 inches. Bridget soils also have less clay in the profile than the Kadoka soil and are on stream terraces and foot slopes. Thirtynine soils are very deep and are lower on the landscape than the Kadoka soil. Epping soils have siltstone within a depth of 20 inches and are on knolls and ridgetops. Included soils make up 10 to 15 percent of the unit.

Permeability and available water capacity are moderate in the Kadoka soil. Runoff is slow. The organic matter content is moderate. The water intake rate is moderately low.

Most of the acreage of this soil is used for dryland farming. A few areas are irrigated. The rest is used mainly for range.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Soil blowing is a slight hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to conserve soil moisture. Cover crops also help to control erosion. Returning crop residue to the soil helps improve the organic matter content and the water intake rate.

If irrigated, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. It is suited to sprinkler and gravity irrigation systems. Some land leveling is generally needed if gravity systems are used so that the distribution of water is uniform. Soil blowing is a slight hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to conserve soil moisture. Incorporating crop residue and

green manure crops into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water leach plant nutrients below the root zone.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with other crops as part of the crop rotation. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or trefoil, or warm-season grasses, such as switchgrass or big bluestem, on pasture and hayland. Continuous heavy grazing causes poor plant vigor. Managing separate pastures of cool- and warm-season grasses can extend the grazing season. Rotation grazing and proper stocking rates help to maintain or improve the condition of the grasses. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be applied by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants. Range seeding may be needed to stabilize severely eroded areas of cropland.

This soil is suited to the trees and shrubs planted in windbreaks. The principal limitations are the restricted rooting depth and the moderate available water capacity. The lack of sufficient seasonal rainfall is a hazard. Irrigation can provide supplemental moisture during periods of low rainfall. The undesirable grasses and weeds can be controlled by cultivation with conventional equipment, rototilling, hoeing by hand, or the careful use of the appropriate kind of herbicide.

The use of this soil for septic tank absorption fields is limited by depth to bedrock. Mounding the site with several feet of suitable fill material improves the filtering capacity of the soil. This soil is generally suited to sites for dwellings without basements. The soft bedrock needs to be excavated for the construction of dwellings with basements or buildings that have deep foundations. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance. Crowning the roads by grading and constructing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIc-1, dryland, and I-4, irrigated; Silty range site; and windbreak suitability group 6R.

KdC—Kadoka silt loam, 2 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on upland side slopes. It formed in silty material weathered from siltstone. Areas range from 10 to 100 acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 5 inches thick. The subsoil is about 15 inches thick. The upper part is grayish brown, friable silty clay loam, and the lower part is light brownish gray, friable, calcareous silt loam. The underlying material is white, friable, calcareous loam about 7 inches thick. Siltstone is below a depth of 27 inches. In some places the surface layer is loam. In cultivated areas 15 to 35 percent of this soil is eroded. In these areas erosion has removed all or most of the original surface soil, and tillage has mixed the remaining surface soil with the subsoil. In some places the surface layer is light in color and calcareous. In other places the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Bridget, Epping, and Thirtynine soils. Bridget and Thirtynine soils do not have bedrock within a depth of 60 inches. Bridget soils have less clay in the profile than the Kadoka soil and are on stream terraces and foot slopes. Epping soils have siltstone within a depth of 20 inches and are on knolls and ridgetops. Thirtynine soils are lower on the landscape than the Kadoka soil. Included soils make up 10 to 15 percent of the unit.

Permeability and available water capacity are moderate in the Kadoka soil. Runoff is medium. The organic matter content is moderate. The water intake rate is moderately low.

Most of the acreage of this soil is used for dryland farming. A few areas are irrigated. The rest is used mainly for range.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Water erosion and soil blowing are the principal hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to conserve soil moisture and control soil blowing and water erosion. Terracing and contour farming are also effective in

controlling erosion and conserving moisture. Returning crop residue to the soil helps improve the organic matter content and the water intake rate.

If irrigated, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. It is best suited to sprinkler irrigation systems because of the slope. Extensive land leveling is needed to prepare this soil for gravity irrigation systems. Water erosion and soil blowing are the principal hazards. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control erosion and conserve soil moisture. The use of cover crops during the winter also helps to control erosion. Incorporating crop residue and green manure crops into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water leach plant nutrients below the root zone and result in the hazard of water erosion on the slopes.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or trefoil, or warm-season grasses, such as switchgrass or big bluestem, on pasture or hayland. This soil is subject to water erosion. Continuous heavy grazing causes poor plant vigor and results in the formation of small gullies and rills after heavy rains. Managing separate pastures of cool- and warm-season grasses can extend the grazing season. Rotation grazing and proper stocking rates help to maintain or improve the condition of the grasses. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be applied by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. As a result, water erosion and soil blowing are excessive. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants.

This soil is suited to the trees and shrubs planted in windbreaks. The principal limitations are the restricted rooting depth and the moderate available water capacity. Erosion and the lack of sufficient seasonal rainfall are the main hazards. Irrigation can provide supplemental moisture during periods of low rainfall. Cultivation between the tree rows with conventional equipment helps to control weeds and grasses that compete with the trees for moisture. Competing vegetation in the tree rows needs to be controlled by rototilling, hoeing by hand, or the careful use of selected herbicides. Planting the trees on the contour helps to control water erosion.

The use of this soil for septic tank absorption fields is limited by depth to bedrock. Mounding the site with several feet of suitable fill material improves the filtering capacity of the soil. This soil is generally suited to sites for dwellings without basements. Buildings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. The soft bedrock needs to be excavated for the construction of dwellings with basements or buildings that have deep foundations. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance. Crowning the roads by grading and constructing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIIe-1, dryland, and IIIe-4, irrigated; Silty range site; and windbreak suitability group 6R.

KdD—Kadoka silt loam, 6 to 9 percent slopes. This moderately deep, strongly sloping, well drained soil is on upland side slopes. It formed in silty material weathered from siltstone. Areas range from 10 to more than 100 acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 7 inches thick. The subsoil is about 20 inches thick. The upper part is brown, friable silty clay loam, the middle part is pale brown, friable silt loam, and the lower part is very pale brown, friable, calcareous silt loam. The underlying material is very pale brown, calcareous silt loam to a depth of 32 inches. Below this is very pale brown siltstone. In some places the surface layer is loam. In cultivated areas 15 to 35 percent of this soil is eroded. In these areas erosion has removed all or most of the original surface soil, and tillage has mixed the remaining surface soil with the subsoil. In some places the surface layer is light in color and calcareous. In other places the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Bridget, Epping, and Thirtynine soils. Bridget soils have less clay in the profile than the Kadoka soil and do not have siltstone within a depth of 40 inches. These soils are on stream terraces and foot slopes. Epping soils have siltstone at a depth of 10 to 20 inches and are on ridges and shoulders of side slopes.

Thirtynine soils do not have siltstone within a depth of 60 inches and are lower on the landscape than the Kadoka soil. Included soils make up 10 to 15 percent of the unit.

Permeability and available water capacity are moderate in the Kadoka soil. Runoff is medium. The organic matter content is moderate. The water intake rate is moderately low.

Most of the acreage of this soil supports native grasses and is used as range. Some areas are used for cultivated crops.

If dryland farmed, this soil is poorly suited to small grains, alfalfa, and introduced grasses. Inadequate rainfall in summer generally limits crop selection. Erosion is a severe hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and stripcropping, helps to control water erosion and conserves soil moisture. Incorporating crop residue and manure into the soil helps improve the organic matter content and fertility.

If irrigated by a sprinkler system, this soil is poorly suited to corn, small grains, alfalfa, and introduced grasses. Water erosion is a severe hazard in unprotected areas. A system of conservation tillage, such as no-till, that keeps crop residue on the surface helps to control erosion and conserve soil moisture. Returning crop residue and green manure crops to the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can result in the hazard of water erosion on the slopes.

This soil is poorly suited to introduced grasses used as pasture and hayland. These grasses can be rotated with other crops. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or trefoil, or warm-season grasses, such as switchgrass or big bluestem, on pasture or hayland. This soil is subject to water erosion. Continuous heavy grazing causes poor plant vigor and results in the formation of small gullies and rills after heavy rains. Managing separate pastures of cool- and warm-season grasses can extend the grazing season. Rotation grazing and proper stocking rates help to maintain or improve the condition of the grasses. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be applied by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

If this soil is used for range or native hay, the climax vegetation is dominantly big bluestem, blue grama, little bluestem, sideoats grama, and western wheatgrass. These species make up 65 percent or more of the total annual forage. Buffalograss, switchgrass, needleandthread, prairie junegrass, Scribner panicum, sedges, and forbs make up the rest. If subject to continuous heavy grazing, big bluestem, little bluestem, prairie junegrass, and switchgrass decrease in abundance and are replaced by blue grama, buffalograss, needleandthread, plains muhly, sand dropseed, tall dropseed, western wheatgrass, and forbs. If overgrazing continues for many years, the native grasses lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range. In areas where gullies have formed because of severe water erosion, land shaping or other mechanical practices may be needed to smooth and stabilize the site before it is reseeded.

This soil is suited to the trees and shrubs planted in windbreaks. The principal limitations are the restricted rooting depth and the moderate available water capacity. Water erosion and the lack of sufficient seasonal rainfall are the main hazards. Irrigation can provide supplemental moisture during periods of low rainfall. Competing vegetation needs to be controlled by cultivating between the tree rows with conventional equipment and by rototilling, hoeing by hand, or the careful use of the appropriate kind of herbicide in the tree rows.

The use of this soil for septic tank absorption fields is limited by depth to bedrock. Mounding the site with several feet of suitable fill material improves the filtering capacity of the soil. This soil is generally suited to sites for dwellings with basements or buildings that have deep foundations. Buildings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. Roads should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

The land capability units are IVe-1, dryland, and IVe-4, irrigated; Silty range site; and windbreak suitability group 6R.

Ke—Keith loam, 0 to 1 percent slopes. This very deep, nearly level, well drained soil is on uplands. It formed in loess. Areas range from 10 to 300 acres in size.

Typically, the surface layer is dark grayish brown, very friable loam about 6 inches thick. The subsurface layer is dark grayish brown, very friable loam about 5 inches thick. The subsoil is about 27 inches thick. The upper part is dark grayish brown and grayish brown, firm silty clay loam. The lower part is light gray, friable, calcareous silt loam. The underlying material to a depth of 60 inches or more is light gray, calcareous very fine sandy loam. In some areas calcareous sandstone is at a depth of 40 to 60 inches. In some places the dark surface soil is more than 20 inches thick. In some places the surface layer is silt loam.

Included with this soil in mapping are areas of Lodgepole and Satanta soils. Lodgepole soils are somewhat poorly drained and have more clay in the subsoil than the Keith soil. These soils are in upland depressions. Satanta soils have more sand in the subsoil than the Keith soil and are on similar landscapes. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the Keith soil, and available water capacity is high. Runoff is slow. The organic matter content is moderate. The water intake rate is moderately low.

Most of the acreage of this soil is farmed. About half of the cultivated areas are irrigated, and the rest is used for dryland farming. The remaining areas are used as range.

If dryland farmed, this soil is suited to small grains, alfalfa, and introduced grasses. The lack of adequate seasonal rainfall commonly limits the crops that can be successfully grown. Soil blowing is a slight hazard in areas where the surface is not protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to control soil blowing and conserve soil moisture. Returning crop residue and green manure crops to the soil helps to maintain the organic matter content and fertility. Stripcropping can help to control soil blowing. Summer fallowing conserves moisture for use during the following growing season.

If irrigated, this soil is suited to corn, sugar beets, field beans, small grains, alfalfa, and introduced grasses. It is suited to sprinkler and gravity irrigation systems. If gravity systems are used, some land leveling is needed to achieve uniform distribution of irrigation water. Soil blowing is a slight hazard if the surface is unprotected. A system of conservation tillage, such as ecofallow or no-till, that keeps crop residue on the surface helps to control soil blowing. Returning crop residue and green manure crops to the soil helps to maintain the organic matter content and increases the water intake rate. Irrigation systems need to be designed so that the water application rate does not exceed the moderately low intake rate of this soil. A tailwater recovery system can be used to conserve water.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall is the principal hazard affecting seedlings and young trees. Competing vegetation between the tree rows can be controlled by cultivation with conventional equipment. The undesirable grasses or weeds in the rows can be controlled by rototilling, hoeing by hand, or the careful use of the appropriate kind of herbicide. Irrigation can provide supplemental moisture during periods of low rainfall.

This soil is generally suited to sites for dwellings and buildings with basements. The moderate permeability is a limitation on sites for septic tank absorption fields. Increasing the size of the absorption

field can generally overcome this limitation. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil material. Coarser grained base material can be used to ensure better performance. A good surface drainage system can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIc-1, dryland, and I-4, irrigated; Silty range site; and windbreak suitability group 3.

KeB—Keith loam, 1 to 3 percent slopes. This very deep, very gently sloping, well drained soil is on uplands. It formed in loess. Areas range from 10 to 400 acres in size.

Typically, the surface layer is dark grayish brown, very friable loam about 9 inches thick. The subsoil is about 19 inches thick. The upper part is grayish brown and brown, firm silty clay loam, and the lower part is pale brown, friable, calcareous silty clay loam. The underlying material to a depth of 60 inches or more is light gray and very pale brown, calcareous silt loam. In some areas calcareous sandstone is at a depth of 40 to 60 inches. In a few places the surface soil is silt loam.

Included with this soil in mapping are small areas of Lodgepole and Satanta soils. Lodgepole soils have more clay in the subsoil than the Keith soil and are somewhat poorly drained. These soils are in upland depressions. Satanta soils have more sand in the subsoil than the Keith soil and are on similar landscapes. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Keith soil, and available water capacity is high. Runoff is slow. The organic matter content is moderate. Tilth is good. The water intake rate is moderately low.

Most of the acreage of this soil is farmed. About half of the cultivated areas are used for dryland farming, and the rest is irrigated. The remaining areas are used for range.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall generally limits the cultivated crops that can be successfully grown. Soil blowing and water erosion are hazards. A system of conservation tillage, such as stubble mulching and ecofallow, keeps crop residue on the surface and helps to conserve soil moisture. These practices also help to control soil blowing and water erosion after locally heavy rains. Returning crop residue and green manure crops to the soil helps to maintain the organic matter content and fertility. Contour farming or stripcropping can also help to control soil blowing and water erosion. Summer fallowing conserves moisture for use during the following growing season.

If irrigated, this soil is suited to sugar beets, field beans, corn, small grains, alfalfa, and introduced grasses. It is suited to sprinkler and gravity irrigation systems. Some land leveling is needed for gravity irrigation systems. A system of conservation tillage, such as no-till or ecofallow, keeps crop residue on the surface and helps to control soil blowing and water erosion. Returning crop residue to the soil also helps to maintain the organic matter content and fertility and conserves soil moisture. Irrigation systems need to be designed so that the water application rate does not exceed the moderately low intake rate of this soil. A tailwater recovery system can be used to conserve irrigation water.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate rainfall is the principal hazard affecting seedlings and young trees. Seedlings can survive and grow if competing vegetation between the tree rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the rows can be

controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide. Planting an annual cover crop between the tree rows helps to control erosion. Irrigation can provide supplemental moisture during periods of low rainfall.

This soil is generally suited to sites for dwellings and buildings with basements. The moderate permeability is a limitation on sites for septic tank absorption fields. Increasing the size of the absorption field can generally overcome this limitation. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil material. Coarser grained base material can be used to ensure better performance. A good surface drainage system can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIe-1, dryland, and IIe-4, irrigated; Silty range site; and windbreak suitability group 3.

KeC—Keith loam, 3 to 6 percent slopes. This very deep, gently sloping, well drained soil is on ridgetops and side slopes on uplands. It formed in loess. Areas range from 10 to about 100 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 6 inches thick. The subsoil is about 22 inches thick. It is dark grayish brown and grayish brown, friable silty clay loam in the upper part and pale brown, friable, calcareous silt loam in the lower part. The underlying material is light gray, calcareous silt loam to a depth of more than 60 inches. In some places the surface layer is silt loam. In some areas calcareous sandstone is at a depth of 40 to 60 inches. In cultivated areas 5 to 20 percent of this soil is eroded. In these areas erosion has removed all or most of the original surface soil, and tillage has mixed the remaining surface soil with the subsoil. In most places the surface layer is light in color and calcareous. In some places the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Satanta soils, which have more sand in the subsoil than the Keith soil and are on similar landscapes. Included soils make up about 10 to 15 percent of the unit.

Permeability is moderate in the Keith soil, and available water capacity is high. Runoff is medium. The organic matter content is moderate. The water intake rate is moderately low.

Most of the acreage of this soil is dryland farmed. A few areas are irrigated. The rest is mainly used as range.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Soil blowing and water erosion are the principal hazards in areas where the surface is not protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, that keeps crop residue on the surface helps to control soil blowing and water erosion and helps to conserve soil moisture. Returning crop residue and green manure crops to the soil helps to maintain the organic matter content and fertility. Terracing and contour farming reduce the runoff rate and help to control water erosion. Summer fallowing conserves moisture for use during the following growing season.

If irrigated by a sprinkler system, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. Extensive land leveling is needed for gravity irrigation systems. Soil blowing and water erosion are the principal hazards. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control water erosion and soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing and water erosion. Incorporating crop residue into the soil helps to maintain the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone and result in the hazard of water erosion on the slopes.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Continuous heavy grazing and improper haying also reduce the amount of protective cover and can result in soil blowing and the formation of small gullies and rills after heavy rains. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can

be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing and water erosion. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. As a result, water erosion and soil blowing are excessive. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants. Range seeding may be needed to stabilize severely eroded areas of cropland.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate rainfall and soil erosion are the principal hazards affecting seedlings and young trees. Seedlings can survive and grow if competing vegetation between the tree rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide. Planting an annual cover crop between the tree rows helps to control soil blowing and water erosion. Irrigation can provide supplemental moisture during periods of low rainfall.

This soil is generally suited to sites for dwellings and buildings with basements. The moderate permeability is a limitation on sites for septic tank absorption fields. Increasing the size of the absorption field can generally overcome this limitation. Buildings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil material. Coarser grained base material can be used to ensure better performance. A good surface drainage system can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIIe-1, dryland, and IIIe-4, irrigated; Silty range site; and windbreak suitability group 3.

Kg—Keith loam, gravelly substratum, 0 to 1 percent slopes. This very deep, nearly level, well drained soil is on uplands. This soil formed in loess deposited over gravelly sediment. Areas range from 5 to 320 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 7 inches thick. The subsurface layer is dark grayish brown, friable loam about 5 inches thick. The subsoil is about 18 inches thick. It is grayish brown, friable clay loam in the upper part and light brownish gray, very friable, calcareous loam in the lower part. The underlying material is light gray, calcareous loam to a depth of 49 inches. Below this to a depth of 60 inches or more is white, calcareous gravelly coarse sand. In some places the dark surface soil is more than 20 inches thick. In some areas the surface soil is clay loam that is exposed during land leveling. In other areas the gravelly material is below a depth of 60 inches. In some places gravelly coarse sand is within a depth of 40 inches because of the cuts made during land leveling.

Included with this soil in mapping are small areas of Bridget soils, which are calcareous within 15 inches of the surface. These soils contain less clay in the solum than the Keith, gravelly substratum, soil and are lower on the landscape. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the solum and the underlying material in the Keith, gravelly substratum, soil and very rapid in the substratum. Available water capacity is moderate. The organic matter content is moderate. Runoff is slow. The water intake rate is moderately low.

Most of the acreage of this soil is used for irrigated crops. The rest is used mainly for dryland crops.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Soil blowing is a slight hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to conserve soil moisture and control soil blowing. Returning crop residue to the soil helps to maintain the organic matter content and the water intake rate.

If irrigated, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. It is suited to sprinkler and gravity irrigation systems. Some land leveling is generally needed for gravity systems to ensure the uniform distribution of water. Soil blowing is a slight hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. Incorporating crop residue into the soil helps to maintain the organic matter content and fertility. Irrigation systems should be designed so that the water application rate does not exceed the moderately low intake rate of this soil. A tailwater recovery system can be used to conserve irrigation water.

This soil is suited to introduced grasses used as

pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants very effectively controls soil blowing. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate rainfall is the principal hazard affecting seedlings and young trees. Seedlings can survive and grow if competing vegetation between the tree rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide. Planting an annual cover crop between the tree rows helps to control soil blowing. Irrigation can provide supplemental moisture during periods of low rainfall.

This soil is generally suited to sites for dwellings and buildings with basements. Because of the very rapid permeability of the gravelly substratum, this soil does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. Mounding the site with several feet of suitable fill material improves the filtering capacity of the soil. The moderate permeability of this soil is a limitation affecting septic tank absorption fields, but increasing the size of the absorption field can generally overcome this limitation. The sides of shallow excavations can cave in unless they are shored. A good surface drainage system can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIc-1, dryland, and I-4, irrigated; Silty range site; and windbreak suitability group 3.

KgB—Keith loam, gravelly substratum, 1 to 3 percent slopes. This very deep, very gently sloping, well drained soil is on uplands. This soil formed in loess deposited over gravelly sediment. Areas range from 10 to 100 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 8 inches thick. The subsoil is about 17 inches thick. It is grayish brown, firm clay loam in the upper part and brown, friable, calcareous loam in the lower part. The underlying material is light gray, calcareous loam to a depth of 45 inches. Below this to a depth of more than 60 inches is white, calcareous gravelly coarse sand. In a few places gravelly coarse sand is below a depth of 60 inches. In some areas the dark surface soil is more than 20 inches thick. In some places the surface layer is silt loam. In a few areas the surface layer is light in color or the gravelly substratum is within a depth of 40 inches because of the cuts made during land leveling.

Included with this soil in mapping are small areas of Bridget soils, which have less clay in the profile than the Keith, gravelly substratum, soil. These soils do not have a gravelly substratum. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the profile in the Keith, gravelly substratum, soil and very rapid in the gravelly substratum. Available water capacity is moderate. The organic matter content is moderate. Runoff is slow. The water intake rate is moderately low.

Most of the acreage of this soil supports irrigated crops. A few areas are dryland farmed. A few small areas are used for grazing.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Water erosion and soil blowing are hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to conserve soil moisture and control soil blowing and water erosion. Returning crop residue to the soil helps improve the organic matter content, fertility, and the water intake rate.

If irrigated, this soil is suited to sugar beets, field beans, corn, small grains, alfalfa, and introduced

grasses. It is suited to sprinkler and gravity irrigation systems. Some land leveling is generally needed for gravity systems to ensure the uniform distribution of water. A system of conservation tillage, such as no-till or ecofallow, that keeps crop residue on the surface helps to control soil blowing and water erosion. Returning crop residue to the soil helps to maintain the organic matter content and fertility and improves the water intake rate. Irrigation systems need to be designed so that the water application rate does not exceed the moderately low intake rate of the soil. A tailwater recovery system can be used to conserve irrigation water.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate rainfall is the principal hazard affecting seedlings and young trees. Seedlings can survive and grow if competing vegetation between the tree rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide. Planting an annual cover crop between the tree rows helps to control erosion. Irrigation can provide supplemental moisture during periods of low rainfall.

Because of the very rapid permeability of the gravelly substratum, this soil does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. Mounding the site with several feet of suitable fill material improves the filtering capacity of the soil. The moderate permeability is a limitation on sites for septic tank absorption fields. Increasing the size of the absorption field can generally overcome this limitation. This soil is generally suited to sites for dwellings and buildings with basements. The sides of shallow excavations can cave in unless they are shored. A good surface drainage system can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIe-1, dryland, and IIe-4, irrigated; Silty range site; and windbreak suitability group 3.

KgC—Keith loam, gravelly substratum, 3 to 6 percent slopes. This very deep, gently sloping, well drained soil is on uplands. The soil formed in loess deposited over gravelly sediment. Areas range from 5 to 50 acres in size.

Typically, the surface layer is dark grayish brown, very friable loam about 7 inches thick. The subsoil is about 16 inches thick. The upper part is grayish brown, firm clay loam, and the lower part is brown, friable, calcareous loam. The underlying material is pale brown, calcareous loam to a depth of 42 inches. Below this to a depth of 60 inches or more is pale brown, calcareous gravelly coarse sand. In a few places gravelly material is below a depth of 60 inches. In some places the surface layer is silt loam. In a few small areas the light colored subsoil or gravelly coarse sand is exposed at the surface because of the cuts made during land leveling.

Included with this soil in mapping are small areas of Jayem and Satanta soils. The included soils have more sand in the subsoil than the Keith, gravelly substratum, soil. They are on similar landscapes. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the profile in the Keith, gravelly substratum, soil and very rapid in the gravelly substratum. Available water capacity is moderate. The organic matter content is moderate. Runoff is medium. The water intake rate is moderately low.

Most of the acreage of this soil is irrigated cropland. A few areas are dryland farmed.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. The lack of adequate rainfall commonly limits the cultivated crops that can

be grown successfully. Soil blowing and water erosion are the principal hazards in areas where the surface is not protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, that keeps crop residue on the surface helps to control erosion and conserve soil moisture. Returning crop residue to the soil also helps to maintain the organic matter content and fertility. Terracing and contour farming reduce the runoff rate and help to control erosion. Summer fallowing conserves moisture for use during the following growing season.

If irrigated by a sprinkler system, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. Extensive land leveling is needed for gravity irrigation systems. Soil blowing and water erosion are the principal hazards. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control water erosion and soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing and water erosion. Incorporating crop residue into the soil improves the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients and result in the hazard of water erosion on the slopes.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. This soil is subject to water erosion. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Continuous heavy grazing and improper haying also reduce the amount of protective cover and can result in soil blowing and the formation of small gullies and rills after heavy rains. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. As a result, water erosion and soil blowing are excessive. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants. Range seeding may be needed to stabilize severely eroded areas of cropland.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate rainfall and soil erosion are the principal hazards affecting seedlings and young trees. Seedlings can survive and grow if competing vegetation between the tree rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide. Planting an annual cover crop between the tree rows helps to control soil blowing and water erosion. Planting trees on the contour helps to control water erosion. Irrigation can provide supplemental moisture during periods of low rainfall.

Because of the very rapid permeability of the gravelly substratum, this soil does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. Mounding the site with several feet of suitable fill material improves the filtering capacity of the soil. The moderate permeability is a limitation on sites for septic tank absorption fields. Increasing the size of the absorption field can generally overcome this limitation. This soil is generally suited to sites for dwellings and buildings with basements. The sides of shallow excavations can cave in unless they are shored. A good surface drainage system can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIIe-1, dryland, and IIIe-4, irrigated; Silty range site; and windbreak suitability group 3.

Ky—Keya loam, 0 to 2 percent slopes. This very deep, nearly level, well drained soil is in upland swales. The soil formed in local loamy alluvium. Areas range from 10 to 150 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 6 inches thick. The subsurface layer is about 11 inches thick. It is similar to the surface layer in color and texture. The subsoil is about 32 inches thick. It is dark grayish brown and grayish brown, firm clay loam in the upper part and pale brown, friable, calcareous loam in the lower part. The

underlying material is very pale brown, calcareous loam to a depth of more than 60 inches. In a few areas the surface layer is fine sandy loam, very fine sandy loam, or loamy fine sand. In some places calcareous sandstone is at a depth of 40 to 60 inches. In some areas strata of gravelly sand is below a depth of 40 inches.

Included with this soil in mapping are small areas of Duroc, Tuthill, and Vetal soils. Duroc soils contain less sand in the profile than the Keya soil and are on similar landscapes. Tuthill soils have a dark surface soil less than 20 inches thick and have fine sand at a depth of 20 to 40 inches. These soils are higher on the landscape than the Keya soil. Vetal soils have more sand in the profile than the Keya soil and are on similar landscapes. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Keya soil, and available water capacity is high. Runoff is slow. The organic matter content is moderate. The surface layer is easily tilled throughout a wide range of moisture content. The water intake rate is moderate.

Most of the acreage of this soil is dryland farmed, and a few acres are irrigated. The rest of the acreage is used for range.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Soil blowing is a slight hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to control soil blowing and conserve soil moisture. Returning crop residue to the soil helps to maintain the organic matter content and fertility and improves the water intake rate.

If irrigated, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. It is suited to sprinkler and gravity irrigation systems. Some land leveling is generally needed for gravity systems to ensure the uniform distribution of water. Soil blowing is a slight hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. Returning crop residue to the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler or gravity systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate rainfall is the principal hazard affecting seedlings and young trees. Seedlings can survive and grow if competing vegetation between the tree rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide. Irrigation can provide supplemental moisture during periods of low rainfall.

The moderate permeability is a limitation on sites for septic tank absorption fields. Increasing the size of the absorption field can generally overcome this limitation. Strengthening the foundations of buildings and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The land capability units are IIc-1, dryland, and I-4, irrigated; Silty range site; and windbreak suitability group 3.

La—Las Animas loam, 0 to 2 percent slopes. This very deep, nearly level, somewhat poorly drained soil is on bottom land. It is subject to occasional

flooding. The soil formed in stratified, calcareous loamy and sandy alluvium. Areas range from 5 to 40 acres in size.

Typically, the surface layer is gray, very friable, calcareous loam about 5 inches thick. The underlying material extends to a depth of 60 inches or more. It is light gray, mottled, calcareous very fine sandy loam in the upper part and light gray, mottled fine sand stratified with calcareous very fine sandy loam in the lower part. In some places the surface layer is loamy fine sand, fine sandy loam, or very fine sandy loam. In other places sandy material is within a depth of 40 inches. In a few areas a dark surface soil is more than 7 inches thick.

Included with this soil in mapping are small areas of Bolent and Calamus soils. The included soils have more sand in the profile than the Las Animas soil. Bolent soils are on similar landscapes as the Las Animas soil. Calamus soils are moderately well drained and are higher on the landscape than the Las Animas soil. Some areas are moderately affected or strongly affected by sodium. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Las Animas soil, and available water capacity is moderate. The organic matter content is moderately low. Runoff is slow. The water intake rate is moderately high. This soil has a seasonal high water table that ranges from a depth of 1.5 feet during wet years to 3.0 feet during most dry years.

Most of the acreage of this soil is used as range and hayland.

If this soil is used as range or hayland, the climax vegetation is dominantly big bluestem, little bluestem, indiangrass, switchgrass, and sedges. These species make up 60 percent or more of the total annual forage. Prairie cordgrass, bluegrass, rushes, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, big bluestem, little bluestem, indiangrass, switchgrass, and prairie cordgrass decrease in abundance and are replaced by western wheatgrass, bluegrass, slender wheatgrass, green muhly, sedges, and rushes. If overgrazing or improper haying continues for many years, bluegrass, sedges, rushes, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 1.6 animal unit months per acre. A planned grazing system that includes proper grazing use, timely deferments from grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. Areas of this soil are generally the first to be overgrazed in a pasture that includes the better drained, sandy soils. Properly located fences and livestock watering and salting facilities result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. The hay is of best quality when the grasses are cut early.

This soil is suited to the trees and shrubs planted in windbreaks. The main limitation affecting the establishment of windbreaks is the wetness caused by the high water table. The species selected for planting should be those that can withstand the occasional wetness. Tilling and planting seedlings should be delayed until after the soil has begun to dry. Seedlings can survive and grow if competing vegetation between the tree rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

This soil is not suited to sanitary facilities and building sites because of the flooding. A suitable alternative site should be selected. The sides of shallow excavations can cave in unless they are shored. The excavations should be made during dry periods. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate side ditches, and installing culverts help protect roads from the damage caused by floodwater and the wetness caused by the seasonal high water table.

The land capability units are IIw-4, dryland, and IIw-8, irrigated; Subirrigated range site; and windbreak suitability group 2S.

Lg—Lodgepole silt loam, 0 to 1 percent slopes. This very deep, nearly level, somewhat poorly drained soil is in depressions on uplands. It formed in loess and loamy sediments. It is occasionally ponded for short periods by runoff from the adjacent uplands. Areas range from 5 to 15 acres in size.

Typically, the surface layer is dark gray, friable silt loam about 5 inches thick. The subsoil is about 35 inches thick. The upper part is dark gray and grayish brown, very firm silty clay, and the lower part is pale brown, friable, mottled loam. The underlying material to a depth of 60 inches or more is light gray, calcareous loam in the upper part and very pale brown, calcareous fine sandy loam in the lower part. In some places the surface layer is loam. In other places sandy underlying material is within a depth of 40 inches. In a few areas of this soil on the Mirage Flats, gravelly coarse sand is below a depth of 40 inches.

Included with this soil in mapping are small areas of

Duroc and Onita soils. Duroc soils have less clay in the subsoil than the Lodgepole soil and are better drained. These soils are higher on the landscape. Onita soils are moderately well drained and are higher on the landscape than the Lodgepole soil. Included soils make up about 5 percent of the unit.

Permeability is very slow in the Lodgepole soil. Available water capacity is high, and the organic matter content is moderate. Runoff is ponded for a brief period. The water intake rate is low. This soil has a perched water table that ranges from 0.5 foot above the surface during wet years to about 1.0 foot below the surface during dry years. The surface layer is saturated for long periods in most years by the perched water table.

Most of the acreage of this soil is used as cropland. A few areas are used for range.

If dryland farmed, this soil is poorly suited to small grains, introduced grasses, and alfalfa. The wetness caused by the perched water table is the principal hazard. A system of conservation tillage, such as stubble mulching, keeps crop residue on the surface, helps to conserve soil moisture, and controls soil blowing during periods when the soil is not ponded. Returning crop residue to the soil helps to maintain or improve the organic matter content and fertility and also improves the water intake rate.

If irrigated, this soil is poorly suited to corn and alfalfa. The wetness caused by the perched water table and the ponding are management concerns. This soil is suited to sprinkler and gravity irrigation systems, but it is best suited to sprinkler systems. Adjusting the application rate to the low water intake rate helps to prevent the ponding. Other management practices are similar to those used if this soil is dryland farmed.

This soil is poorly suited to introduced grasses used as pasture and hayland. These grasses can be rotated with other crops. Continuous heavy grazing or grazing during wet periods causes compaction and poor tilth. Excessive wetness limits the choice of pasture grasses and legumes. Grazing when the soil is too wet results in damage to the grass stand. Because of the wetness, establishing a good stand of grass can be difficult. Managing separate pastures of cool- and warm-season grasses can extend the grazing season.

This soil is suited to native grasses used as range and hayland. Overgrazing by livestock, improper haying periods, or improper mowing heights reduces the protective vegetative cover and the quality of the native plants. Proper degree of use, a planned grazing system, and timely deferments from grazing or haying help to maintain or improve the range condition. Rotation grazing and proper stocking rates help to maintain the grasses in good condition.

This soil is suited to the trees and shrubs planted in windbreaks. The wetness caused by the perched water table and the ponding are major concerns affecting the establishment of windbreaks. The species selected for planting should be those that can withstand the occasional wetness. Onsite investigation is needed to identify the areas that are best suited to windbreaks.

This soil is not suited to sites for septic tank absorption fields or buildings because of the ponding. A suitable alternative site should be selected. Constructing roads on suitable, well compacted fill material above the level of ponding, providing adequate side ditches, and installing culverts help protect roads from the damage caused by flooding. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance. Mixing the base material with additives, such as hydrated lime, can help to prevent excessive shrinking and swelling.

The land capability units are IIIw-2, dryland, and IVw-2, irrigated; Clayey Overflow range site; and windbreak suitability group 2W.

Lu—Lute loam, 0 to 2 percent slopes. This very deep, nearly level, somewhat poorly drained soil is on alluvial fans and low stream terraces. It formed in loamy alluvium. This soil is subject to rare flooding. Areas range from 5 to 200 acres in size.

Typically, the surface layer is dark gray, friable loam about 6 inches thick. The subsurface layer is light brownish gray, friable loam about 1 inch thick. The subsoil is about 17 inches thick. It is gray, firm, calcareous sandy clay loam in the upper part and grayish brown, very friable, calcareous, mottled very fine sandy loam in the lower part. The underlying material is stratified light gray, calcareous very fine sandy loam to a depth of 60 inches or more. In some places the surface layer is fine sandy loam or loamy fine sand. In other places the subsoil is clay loam. In other places the underlying material is stratified loam or clay loam.

Included with this soil in mapping are small areas of Beckton and Satanta soils. Beckton soils are moderately well drained and are higher on the landscape than the Lute soil. Satanta soils are well drained and are not sodium-affected. These soils are higher on the landscape than the Lute soil. Included soils make up 5 to 10 percent of the unit.

Permeability is slow in the subsoil in the Lute soil and moderately rapid in the underlying material. Available water capacity is moderate. The organic

matter content is moderate. Runoff is slow. This soil has poor tilth. It takes in water slowly, and water may accumulate in the microdepressions for short periods. This soil has a high content of sodium. It has a perched water table that ranges from a depth of about 1 foot to 3 feet.

All of the acreage of this soil supports native grasses used for hay or grazing.

This soil is not suited to farming because of the high content of sodium.

If this soil is used as range, either for grazing or hay, the climax vegetation is dominated by cordgrass, inland saltgrass, and western wheatgrass. These species make up 90 percent or more of the total annual forage. Foxtail barley, slender wheatgrass, switchgrass, bluegrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, alkali sacaton, western wheatgrass, and switchgrass decrease in abundance and are replaced by inland saltgrass, blue grama, bluegrass, foxtail barley, sand dropseed, and alkali tolerant sedges. If overgrazing or improper haying continues for many years, inland saltgrass, blue grama, bluegrass, foxtail barley, alkali tolerant sedges, rushes, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain and improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. The alkalinity limits forage production and greatly influences the kinds of plants that grow. Some areas of very strongly alkaline soils support little or no vegetation and are subject to a severe hazard of soil blowing during dry periods. Careful management is needed to maintain the plant cover.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous.

This soil is not suited to the trees and shrubs planted in windbreaks. A few areas may be suitable for the trees or shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

Constructing septic tank absorption fields on fill material raises the fields a sufficient distance above the seasonal high water table. Constructing dwellings and buildings on raised, well compacted fill material helps to overcome the wetness caused by the high water table and helps to prevent the damage caused by floodwater. The sides of shallow excavations can cave in unless they are shored. The excavations should be made during dry periods. A good surface drainage system and a gravel moisture barrier in the subgrade can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate side ditches, and installing culverts help to prevent the damage to roads caused by the flooding and the wetness.

The land capability unit is VIs-1, dryland; Saline Subirrigated range site; and windbreak suitability group 10.

MbC—Manvel silty clay loam, 2 to 6 percent slopes. This very deep, gently sloping, well drained soil is on alluvial fans and foot slopes. It formed in calcareous colluvial and alluvial sediments derived from interbedded chalk and shale. Areas range from 20 to 600 acres in size.

Typically, the surface layer is light brownish gray, friable, calcareous silty clay loam about 5 inches thick. The transitional layer is light brownish gray, friable, calcareous silty clay loam about 6 inches thick. The underlying material is calcareous silty clay loam to a depth of more than 60 inches. The upper part is light gray, and the lower part is pale yellow. In some places the surface layer is silt loam or loam. In some areas interbedded chalk and shale is at a depth of 40 to 60 inches. In other places the underlying material is strongly alkaline.

Included with this soil in mapping are small areas of Bufton soils, which contain more clay than the Manvel soil and are higher on the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately slow in the Manvel soil. Available water capacity is high. The organic matter content is moderately low. Runoff is slow and medium. The water intake rate is moderate.

Most of the acreage of this soil is used as dryland cropland. The rest supports native grasses used for range.

If dryland farmed, this soil is poorly suited to small grains, introduced grasses, and alfalfa. The lack of adequate seasonal rainfall commonly limits the cultivated crops that can be grown. Soil erosion is the principal hazard if the surface is not protected by crops or crop residue. A system of conservation tillage, such as stubble mulching, ecofallow, and stripcropping, that keeps crop residue on the surface helps to control water erosion and soil blowing and conserve soil moisture. Returning crop residue to the soil also helps to maintain the organic matter content

and fertility. Summer fallowing conserves moisture for use during the following growing season. Terraces and contour farming help to control water erosion.

If irrigated, this soil is poorly suited to alfalfa, small grains, and introduced grasses. It is suited to sprinkler and gravity irrigation systems. Extensive land leveling is needed for gravity systems to ensure the uniform distribution of water. Timely application and efficient distribution of water are needed. Erosion control practices are similar to those used if this soil is dryland farmed.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with other crops. Rotation grazing and proper stocking help to maintain or improve the condition of the grasses. Managing separate pastures of cool- and warm-season grasses can extend the grazing season.

If this soil is used as range, the climax vegetation is dominated by blue grama, needlegrass, and threadleaf sedge. These species make up 70 percent or more of the total annual production. Buffalograss, western wheatgrass, little bluestem, sideoats grama, prairie sandreed, and other annual and perennial grasses, forbs, and shrubs make up the rest. If subject to continuous heavy grazing, little bluestem decreases in abundance. Initially, this species is replaced by blue grama, hairy grama, prairie sandreed, sand dropseed, western wheatgrass, needleandthread, plains muhly, Sandberg bluegrass, sedges, annual grasses, and forbs. If overgrazing continues for many years, the native grasses lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.6 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities, roads, and trails. The areas away from the watering facilities may be underused. Properly locating fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time salt is provided help to prevent excessive trampling and local overuse. Areas previously used as cropland should be reseeded to a suitable grass mixture. In areas where gullies have formed because of severe water erosion, land shaping or other mechanical practices may be required in addition to deferments from grazing to stabilize the site before it is reseeded.

This soil is suited to the trees and shrubs planted in windbreaks. The species selected for planting should be those that can tolerate a high amount of calcium in the soil. The lack of adequate rainfall is a hazard. Irrigation may be needed to provide supplemental moisture during periods of low rainfall. Planting the trees on the contour and terracing help to control water erosion. Seedlings can survive and grow if competing vegetation between the tree rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

The moderately slow permeability of this soil is a limitation affecting septic tank absorption fields, but increasing the size of the absorption field can generally overcome this limitation. Strengthening the foundations of buildings and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. Buildings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil material. Coarse grained, loose material can be used to ensure better performance.

The land capability units are IVe-1, dryland, and IVe-3, irrigated; Limy Upland range site; and windbreak suitability group 8.

Mc—Marlake fine sandy loam, 0 to 1 percent slopes. This very deep, nearly level, very poorly drained soil is in depressions in sandhill valleys. It formed in eolian sand and sandy alluvium. This soil is subject to frequent ponding by water from a high water table. Individual areas range from 5 to 600 acres in size.

Typically, the surface layer is dark gray, very friable, calcareous fine sandy loam about 7 inches thick. The transitional layer is about 7 inches thick. It is grayish brown, very friable, calcareous loamy fine sand stratified with fine sandy loam and fine sand. The underlying material to a depth of more than 60 inches is light brownish gray, mottled, calcareous loamy fine sand stratified with fine sandy loam and fine sand. In some places the underlying material is not stratified. In a few places the surface layer is loamy fine sand or fine sand. In a few areas the underlying material is fine sandy loam.

Included with this soil in mapping are small areas of Els, Hoffland, and Tryon soils and a few intermittent lakes. The included soils have a lower seasonal high water table than the Marlake soil and are higher on the

landscape. Hoffland soils have a surface soil that has a high content of carbonates. Inclusions make up 5 to 10 percent of this unit.

Permeability is rapid in the Marlake soil, and available water capacity is low. The organic matter content is high. Runoff is ponded. This soil has a seasonal high water table that ranges from 2 feet above the surface during wet years to 1 foot below the surface during dry years. This soil has water above the surface for long periods during most years. During extended dry periods the water table normally recedes below the surface.

This soil is used as wildlife habitat (fig. 12). Vegetation consists of cattails, rushes, sedges, and other native marsh vegetation.

This soil is too wet for cropland, pasture, or range and for trees and shrubs.

This soil is not suited to septic tank absorption fields or building sites because of the wetness caused by the high water table and the ponding of water on the surface. A suitable alternative site should be selected. Constructing roads on suitable, well compacted fill material above the level of ponding, providing adequate side ditches, and installing culverts help protect roads from the damage caused by ponding and the wetness caused by the seasonal high water table.

The land capability unit is VIIIw-7, dryland, and windbreak suitability group 10. No range site is assigned.

Mk—McCook loam, 0 to 2 percent slopes. This very deep, nearly level, well drained soil is on bottom land. It is subject to rare flooding. The soil formed in stratified, calcareous, loamy alluvium. Areas range from 5 to 200 acres in size.

Typically, the surface layer is grayish brown, friable, calcareous loam about 6 inches thick. The subsurface layer is grayish brown, friable, calcareous loam about 6 inches thick. The transitional layer is stratified, light brownish gray, very friable, calcareous loam about 8 inches thick. Below the transitional layer is a buried surface layer about 13 inches thick that is dark grayish brown, very friable, calcareous loam. The underlying material to a depth of about 45 inches is pale brown, calcareous loam. Below this to a depth of 60 inches or more is another buried surface layer that is grayish brown, calcareous silt loam. In some places carbonates are below a depth of 10 inches. In some areas the dark surface soil is more than 20 inches thick. In some places the surface layer is fine sandy loam or silt loam.

Included with this soil in mapping are small areas of Munjor soils, which have more sand in the profile than the McCook soil and are on similar landscapes. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the McCook soil, and available water capacity is high. The organic matter content is moderate. Runoff is slow. The water intake rate is moderate.

Most of the acreage of this soil is cultivated, and many areas are irrigated. Only a small acreage is used as range.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Soil blowing is a hazard in areas where the surface is not adequately protected by crops or crop residue. This soil is flooded for short periods, and damage to crops is seldom severe. A system of conservation tillage, such as stubble mulching and ecofallow, helps to conserve soil moisture and control soil blowing. The use of cover crops during the winter also helps to control soil blowing. Returning crop residue to the soil helps improve the organic matter content and the water intake rate.

If irrigated, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. It is suited to sprinkler and gravity irrigation systems. Some land leveling is generally needed for gravity systems to ensure the uniform distribution of water. This soil is flooded for short periods, and damage to crops is seldom severe. Soil blowing is the principal hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone.

This soil is suited to introduced grasses used for pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by

Figure 12.—An area of Marlake fine sandy loam, 0 to 1 percent slopes, used as wetland wildlife habitat.

supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range and native hayland. A cover of range plants effectively controls soil blowing and water erosion. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants.

This soil is suited to the trees and shrubs planted in windbreaks. Competing weeds and grasses can be controlled by cultivation with conventional equipment between the tree rows and by hoeing by hand, rototilling, and the careful use of the appropriate kind of herbicide in the rows. Irrigation is needed during dry periods.

The hazard of rare flooding needs to be considered if this soil is used for sanitary facilities and building sites. The moderate permeability of this soil is a limitation affecting septic tank absorption fields, but increasing the size of the absorption fields can generally overcome this limitation. Constructing dwellings and buildings on raised, well compacted fill material helps to prevent the damage caused by floodwater. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate side ditches, and installing culverts help protect roads from the damage caused by floodwater. A good surface drainage system can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIc-1, dryland, and I-6, irrigated; Silty Lowland range site; and windbreak suitability group 1L.

Mm—McCook loam, channeled, 0 to 2 percent slopes. This very deep, nearly level, well drained soil is on bottom land. It formed in stratified, calcareous, loamy alluvium. This soil has an entrenched, meandering stream channel and is subject to frequent flooding. Areas range from 20 to 200 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 10 inches thick. The lower part of the surface layer is calcareous. The transitional layer is pale brown, very friable, calcareous loam about 5 inches thick. The underlying material extends to a depth of 60 inches or more. It is pale brown, calcareous loam in the upper part and light gray, calcareous loam in the lower part. In some places the carbonates are below a depth of 10 inches. In some areas the dark surface soil is more than 20 inches thick. In some places gravelly fine sandy loam is in the underlying material.

Included with this soil in mapping are small areas of Munjor soils, which contain more sand than the McCook soil and are on similar landscapes. Also included are some areas of short, steep slopes along the edges of the channels. Inclusions make up 5 to 10 percent of the unit.

Permeability is moderate in the McCook soil, and available water capacity is high. The organic matter content is moderate. Runoff is slow.

All of the acreage of this unit supports native grasses and is used as range or hayland.

This soil is not suited to farming because of the hazard of frequent flooding. In most places the channels are too steep to be crossed by conventional equipment.

If this soil is used as range or hayland, the climax vegetation is dominantly big bluestem, little bluestem, sideoats grama, and western wheatgrass. These species make up about 70 percent of the total annual forage. Prairie junegrass, switchgrass, green needlegrass, bluegrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, big bluestem, little bluestem, prairie junegrass, and green needlegrass decrease in abundance and are replaced by western wheatgrass, bluegrass, and sedges. Although flooding is very brief, the floodwater deposits debris and weed seeds. Grazing should be delayed on this soil after periods of flooding to prevent compaction.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing.

If this soil is used as hayland, the forage can generally be harvested annually. Mowing should be regulated so that the grasses remain vigorous and healthy.

This soil is not suited to the trees and shrubs planted in windbreaks because of the hazard of flooding. A few areas may be suitable for the trees or shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

This soil is not suited to building sites or septic tank absorption fields because of the flooding. Suitable alternative sites should be selected. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate side ditches, and installing culverts help protect roads from the damage caused by floodwater.

The land capability unit is VIw-7, dryland; Silty Overflow range site; and windbreak suitability group 10.

MxF—Mitchell-Epping complex, 9 to 30 percent slopes. These moderately steep and steep, well drained soils are on uplands. The Mitchell soil is very deep, and the Epping soil is shallow. These soils formed in loamy sediment weathered from siltstone. The Mitchell soil is mainly on the middle and lower side slopes. The Epping soil is on the upper side slopes and on narrow ridgetops and knolls. Areas range from 20 to 500 acres in size. They consist of 50 to 65 percent Mitchell soil and 25 to 40 percent Epping soil. These soils are so intermingled or mixed that separating them in mapping is not practical.

Typically, the Mitchell soil has a surface layer of light brownish gray, very friable, calcareous very fine sandy loam about 4 inches thick. The transitional layer is pale brown, very friable, calcareous very fine sandy loam about 5 inches thick. The underlying material is very pale brown, calcareous very fine sandy loam to a depth of more than 60 inches. In some places the surface layer is loam, silt loam, or fine sandy loam. In other places the siltstone is at a depth of 40 to 60 inches.

Typically, the Epping soil has a surface layer of light brownish gray, very friable very fine sandy loam about 3 inches thick. The transitional layer is pale brown, very friable, calcareous very fine sandy loam about 3 inches thick. The underlying material is very pale

brown, calcareous very fine sandy loam to a depth of 15 inches. Below this to a depth of more than 60 inches is very pale brown siltstone. In some places the surface layer is loam or silt loam.

Included with these soils in mapping are small areas of Thirtynine soils and areas of Badland, which are lower on the landscape than the Mitchell and Epping soils. Thirtynine soils have a thicker and darker surface soil than that of the Mitchell and Epping soils and more clay in the profile. Areas of Badland, which is barren, occur as highly erodible areas of siltstone. Included areas make up 10 to 15 percent of the unit.

Permeability is moderate in the Mitchell and Epping soils. Available water capacity is high in the Mitchell soil and very low in the Epping soil. The organic matter content is moderately low in both soils. Runoff is rapid. Root development is restricted by the underlying siltstone in the Epping soil.

These soils support native grasses and are used as range.

These soils are not suited to cropland because of the steep slope and the shallow root zone of the Epping soil.

If these soils are used as range or hayland, the climax vegetation on the Mitchell soil is dominantly little bluestem, big bluestem, sideoats grama, and blue grama. These species make up 50 percent or more of the total annual forage. Plains muhly, buffalograss, needleandthread, western wheatgrass, and forbs make up the rest. The climax vegetation on the Epping soil is dominantly little bluestem, sideoats grama, western wheatgrass, blue grama, and threadleaf sedge. These species make up 70 percent or more of the total annual forage. Prairie sandreed, hairy grama, sand bluestem, big bluestem, needleandthread, green needlegrass, and forbs make up the rest. If subject to continuous heavy grazing, big bluestem and little bluestem decrease in abundance on the Mitchell soil and little bluestem, sand bluestem, and big bluestem decrease in abundance on the Epping soil. They are replaced by hairy grama, prairie sandreed, tall dropseed, western wheatgrass, needleandthread, plains muhly, sedges, and forbs on the Mitchell soil and sideoats grama, blue grama, hairy grama, prairie sandreed, sand dropseed, threadleaf sedge, and forbs on the Epping soil. If overgrazing continues for many years, the native grasses lose vigor and are unable to stabilize the site. As a result, water erosion is excessive. Woody plants may invade the site on the Epping soil.

If the range is in excellent condition, the suggested initial stocking rate is 0.6 animal unit month per acre on the Mitchell soil and 0.5 animal unit month per acre on the Epping soil. The stocking rate is determined by the percentage of each soil in the pasture. The range should be closely monitored during use and the stocking rates adjusted so that one soil does not become overgrazed.

A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. The slope can hinder the movement of livestock. Brush management may be needed in some areas to control the woody plants that invade the site. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range. In areas where gullies have formed because of severe water erosion, land shaping or other mechanical practices may be needed to smooth and stabilize the site before it is reseeded.

These soils are generally not suited to the trees and shrubs planted in windbreaks because of the steep slope and the shallow depth to bedrock in the Epping soil. A few areas may be suitable for the trees and shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

These soils are generally not suitable for sanitary facilities because of the steep slope and the shallow depth to bedrock in the Epping soil. In areas of the Mitchell soil, dwellings and buildings need to be properly designed so that they conform to the natural slope of the land, or the soil can be graded to a suitable gradient. In areas of the Epping soil, the soft bedrock generally can be excavated during the construction of dwellings with basements or buildings that have deep foundations. Cutting and filling generally can provide a suitable grade for roads. The siltstone in areas of the Epping soil can be excavated during the construction of roads.

The land capability units are VIe-9, dryland, for the Mitchell soil and VIs-4, dryland, for the Epping soil. The Mitchell soil is in the Limy Upland range site, and the Epping soil is in the Shallow Limy range site. Both soils are in windbreak suitability group 10.

My—Munjor fine sandy loam, 0 to 2 percent slopes. This very deep, nearly level, well drained soil is on bottom land. The soil formed in stratified loamy and sandy alluvium. It is subject to rare flooding. Areas range from 5 to 150 acres.

Typically, the surface layer is grayish brown, very friable, calcareous fine sandy loam about 6 inches thick. The calcareous underlying material is stratified brown loamy very fine sand and pale brown fine sandy

loam to a depth of more than 60 inches. In some places the surface layer is loam, very fine sandy loam, sandy loam, or loamy fine sand. In other places carbonates are below a depth of 10 inches.

Included with this soil in mapping are small areas of Bolent, Las Animas, and McCook soils. Bolent soils have more sand in the profile than the Munjor soil and are somewhat poorly drained. These soils are lower on the landscape. Las Animas soils are somewhat poorly drained and are lower on the landscape than the Munjor soil. McCook soils have less sand than the Munjor soil and are on similar landscapes. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Munjor soil, and available water capacity is moderate. The organic matter content is low. Runoff is slow. The water intake rate is moderately high.

Most of the acreage of this soil is used as range or hayland. Some areas are cultivated.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Soil blowing is the main hazard. This soil is flooded for short periods, and damage to crops is seldom severe. A system of conservation tillage, such as stubble mulching and ecofallow, helps to conserve soil moisture and control soil blowing. The use of cover crops during the winter also helps to control soil blowing. Returning crop residue to the soil helps to maintain the organic matter content and fertility and improves the water intake rate.

If irrigated, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. It is suited to sprinkler and gravity irrigation systems. This soil is best suited to sprinkler irrigation systems because of the moderately high water intake rate. Frequent, light applications of irrigation water are needed. This soil is flooded for short periods, and damage to crops is seldom severe. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone.

If this soil is used as range or hayland, the climax vegetation is dominantly sand bluestem, little bluestem, prairie sandreed, needleandthread, and switchgrass. These species make up 65 percent or more of the total annual forage. Blue grama, prairie junegrass, bluegrass, indiangrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, indiangrass, little bluestem, and switchgrass decrease in abundance and are replaced by prairie sandreed, needleandthread, sand dropseed, blue grama, sedges, and forbs. If overgrazing continues for many years, blue grama, sand dropseed, needleandthread, Scribner panicum, sedges, and forbs dominate the site. Under these conditions, the native plants lose vigor and are unable to stabilize the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, mowing should be regulated so that the grasses remain healthy and vigorous. The forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and soil blowing are the main hazards affecting the establishment of windbreaks. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. The weeds and undesirable grasses in the tree rows can be controlled by the careful use of the appropriate kind of herbicide or hoeing by hand. Cultivation between the rows with conventional equipment can control undesirable grasses and weeds in areas where strips of sod and cover crops are not used. Irrigation can provide supplemental moisture during periods of low rainfall.

The hazard of rare flooding needs to be considered if this soil is used for sanitary facilities and building sites. Constructing dwellings and buildings on raised, well compacted fill material helps to prevent the damage caused by floodwater. The sides of shallow excavations can cave in unless they are shored. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate side ditches, and installing culverts help protect roads from the damage caused by floodwater.

The land capability units are IIIe-3, dryland, and IIe-8, irrigated; Sandy Lowland range site; and windbreak suitability group 1L.

Mz—Munjor fine sandy loam, channeled, 0 to 2 percent slopes. This very deep, well drained, nearly level soil is on bottom land along drainageways. The soil formed in stratified loamy and sandy alluvium. It has an entrenched, meandering stream channel and is subject to frequent flooding. Areas are generally long and narrow and range from 20 to 200 acres in size.

Typically, the surface layer is grayish brown, friable fine sandy loam about 5 inches thick. The underlying material to a depth of more than 60 inches is stratified and calcareous. It is light brownish gray, grayish brown, and light gray fine sandy loam in the upper part and light brownish gray loamy very fine sand and loamy fine sand in the lower part. In some places the surface layer is very fine sandy loam, loamy very fine sand, or loam.

Included with this soil in mapping are small areas of McCook and Las Animas soils. McCook soils have a dark surface soil more than 10 inches thick and have more silt in the profile than the Munjor soil. These soils are on similar landscapes. Las Animas soils are somewhat poorly drained and are lower on the landscape than the Munjor soil. Also included are some areas of short, steep slopes along the edges of the channels. Included areas make up 5 to 10 percent of the unit.

Permeability is moderately rapid in the Munjor soil, and available water capacity is moderate. The organic matter content is low. Runoff is slow.

All of the acreage of this soil is used for range. Most of the soil is covered by trees. The dominant vegetation is green ash, boxelder, hackberry, and eastern cottonwood.

This soil is not suited to cropland because of the hazard of frequent flooding.

If this soil is used as range or hayland, the climax vegetation is dominantly prairie sandreed, little bluestem, switchgrass, and sand bluestem. These species make up about 55 percent of the total annual forage. Prairie junegrass, big bluestem, sideoats grama, green needlegrass, western wheatgrass, bluegrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, big bluestem, little bluestem, prairie junegrass, and green needlegrass decrease in abundance and are replaced by western wheatgrass, bluegrass, and sedges. Although flooding is very brief, the floodwater deposits debris and weed seeds. Grazing should be delayed on this soil after periods of flooding to prevent compaction.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing.

If this soil is used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy.

This soil generally is not suited to the trees and shrubs planted in windbreaks because of the hazard of frequent flooding. A few areas may be suitable for the trees or shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

This soil is not suited to septic tank absorption fields and building sites because of the flooding. A suitable alternative site should be selected. The sides of shallow excavations can cave in unless they are shored. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate side ditches, and installing culverts help protect roads from the damage caused by floodwater.

The land capability unit is VIw-7, dryland; Sandy Lowland range site; and windbreak suitability group 10.

OhC—Oglala-Canyon complex, 3 to 6 percent slopes. These gently sloping, well drained soils are on uplands. The Oglala soil is deep, and the Canyon soil is shallow. These soils formed in loamy material weathered from calcareous sandstone. The Oglala soil is on ridgetops and the lower side slopes, and the Canyon soil is on shoulders and the upper side slopes. Areas range from 5 to 500 acres in size. They consist of 45 to 60 percent Oglala soil and 25 to 35 percent Canyon soil. These soils are so intermingled or mixed that separating them in mapping is not practical.

Typically, the Oglala soil has a surface layer of grayish brown, friable loam about 12 inches thick. The transitional layer is pale brown, very friable loam about 8 inches thick. The underlying material is white, calcareous loam to a depth of 45 inches. Below this to a depth of more than 60 inches is white, calcareous sandstone. In some places the surface layer is very fine sandy loam. In cultivated areas 10 to 20 percent of this soil is eroded. In these areas erosion has removed all or most of the original surface soil, and tillage has mixed the remaining surface soil with the subsoil. In most places the surface layer is light in color and calcareous.

Typically, the Canyon soil has a surface layer of

dark grayish brown, very friable loam about 6 inches thick. The transitional layer is grayish brown, calcareous, friable loam about 6 inches thick. The underlying material is calcareous, pale brown loam to a depth of 17 inches. Below this to a depth of more than 60 inches is white, fine grained sandstone. In some places the surface layer is very fine sandy loam. In cultivated areas erosion has removed all or most of the original surface soil, and the thickness of the loamy material over the sandstone bedrock has been reduced. In some of these areas sandstone cobbles and stones have been dislodged by tillage equipment and are on the surface. In these areas the surface layer is light in color and calcareous.

Included with these soils in mapping are small areas of Alliance and Rosebud soils. The included soils have more clay in the profile than the Oglala soil. Rosebud soils are moderately deep over calcareous sandstone. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Oglala and Canyon soils. Available water capacity is high in the Oglala soil and very low in the Canyon soil. The organic matter content is moderate in the Oglala soil and moderately low in the Canyon soil. Runoff is medium. The water intake rate is moderate in the Oglala soil. Root development is restricted by the underlying sandstone in the Canyon soil.

Most of these soils support native grasses and are used as rangeland. A small acreage is used as dryland and irrigated farmland.

If dryland farmed, the Oglala soil is suited to small grains, alfalfa, and introduced grasses. Inadequate rainfall in summer generally limits the cultivated crops that can be grown. Water erosion and soil blowing are the principal hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to control soil blowing and water erosion and conserve soil moisture. Returning crop residue to the soil helps to maintain the organic matter content and fertility and improves the water intake rate. Stripcropping, terraces, and annual cover crops also help to control water erosion and soil blowing. Summer fallowing conserves moisture for use during the following growing season. Terraces are generally difficult to construct because of the shallow depth to bedrock in areas of the Canyon soil.

If irrigated by a sprinkler system, the Oglala soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. Soil blowing is the principal hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and water erosion and conserve soil moisture. The use of winter cover crops also helps to control soil blowing. Incorporating crop residue and green manure crops into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone and result in the hazard of water erosion on the slopes.

The Canyon soil is not suited to dryland farming or irrigation because of the shallow depth to bedrock.

These soils are suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. These soils are subject to erosion. Overgrazing or improper haying causes poor plant vigor and loss of production. Overgrazing and improper haying also reduce the amount of protective cover and can result in soil blowing and the formation of small gullies and rills after heavy rains. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

If these soils are used for range or native hay, the climax vegetation on the Oglala soil is dominantly big bluestem, blue grama, little bluestem, sideoats grama, switchgrass, and western wheatgrass. These species make up 70 percent or more of the total annual forage. Buffalograss, needleandthread, prairie junegrass, Scribner panicum, sedges, and forbs make up the rest. The climax vegetation on the Canyon soil is dominantly little bluestem, sideoats grama, western wheatgrass, blue grama, hairy grama, big bluestem, and threadleaf sedge. These species make up 60 percent or more of the total annual forage. Prairie sandreed, needleandthread, green needlegrass, and forbs make up the rest. If subject to continuous heavy grazing, big bluestem, little bluestem, prairie junegrass, and switchgrass decrease in abundance on the Oglala soil, and little bluestem and big bluestem decrease in abundance on the Canyon soil. They are

replaced by blue grama, buffalograss, needleandthread, plains muhly, sand dropseed, tall dropseed, western wheatgrass, and forbs on the Oglala soil and sideoats grama, blue grama, hairy grama, prairie sandreed, sand dropseed, threadleaf sedge, and forbs on the Canyon soil. If overgrazing continues for many years, the native grasses lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive. Woody plants may invade the site on the Canyon soil.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre on the Oglala soil and 0.5 animal unit month per acre on the Canyon soil. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range. In areas where gullies have formed because of severe water erosion, land shaping or other mechanical practices may be needed to smooth and stabilize the site before it is reseeded. Brush management may be needed in some areas to control the woody plants that invade the site.

The Oglala soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and soil erosion are the principal hazards affecting seedlings and young trees. Seedlings can survive and grow if competing vegetation between the tree rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide. Planting an annual cover crop between the rows helps to control erosion. Irrigation can provide supplemental moisture during periods of low rainfall. The Canyon soil is generally not suited to the trees and shrubs planted in windbreaks because of the shallow depth to bedrock and the very low available water capacity. A few areas may be suitable for the trees or shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

In areas of the Oglala soil, mounding the sites for septic tank absorption fields with several feet of suitable fill material improves the filtering capacity of the soil. The moderate permeability of this soil is also a limitation affecting septic tank absorption fields, but increasing the size of the absorption field can generally overcome this limitation. Land shaping and installing the absorption field on the contour are generally necessary for its proper operation. The Canyon soil is generally not suited to sanitary facilities because of the shallow depth to bedrock. A suitable alternative site should be selected. Buildings should be designed so that they conform to the natural slope of the land, or the soils should be graded to a suitable gradient. In areas of the Canyon soil, the soft bedrock can be excavated during the construction of dwellings with basements or buildings that have deep foundations. A good surface drainage system can minimize the damage to roads caused by frost action in areas of the Oglala soil. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. In areas of the Canyon soil, the soft bedrock can be excavated during the construction of roads. Onsite investigation is needed before any engineering practices are applied.

The land capability units are IIIe-1, dryland, and IIe-6, irrigated, for the Oglala soil and VIs-4, dryland, for the Canyon soil. The Oglala soil is in the Silty range site and windbreak suitability group 3. The Canyon soil is in the Shallow Limy range site and windbreak suitability group 10.

OhD—Oglala-Canyon complex, 6 to 11 percent slopes. These strongly sloping, well drained soils are on uplands. The Oglala soil is deep, and the Canyon soil is shallow. These soils formed in loamy material weathered from calcareous sandstone. The Oglala soil is on ridgetops and the lower side slopes, and the Canyon soil is on the upper side slopes. Areas range from 5 to more than 500 acres in size. They consist of 45 to 60 percent Oglala soil and 25 to 35 percent Canyon soil. These soils are so intermingled or mixed that separating them in mapping is not practical.

Typically, the Oglala soil has a surface layer of dark grayish brown, friable loam about 10 inches thick. The transitional layer is brown, very friable loam about 9 inches thick. The underlying material is light gray and white, calcareous loam to a depth of 51 inches. Below this to a depth of more than 60 inches is white, calcareous sandstone. In some places the surface layer is very fine sandy loam. In cultivated areas 15 to 35 percent of this soil is eroded. In these areas erosion has removed all or most of the original surface soil, and tillage has mixed the remaining surface soil with the subsoil. In most places the surface layer is light in color and calcareous.

Typically, the Canyon soil has a surface layer of dark grayish brown, very friable loam about 3 inches thick. The transitional layer is grayish brown, very friable, calcareous loam about 3 inches thick. The underlying material is light gray, calcareous very fine

sandy loam to a depth of 14 inches. Below this to a depth of more than 60 inches is white, calcareous sandstone. In some places the surface layer is fine sandy loam or very fine sandy loam. In other places the dark surface layer is more than 3 inches thick. In cultivated areas erosion has removed all or most of the original surface soil, and the thickness of the loamy material over the sandstone bedrock has been reduced. In some areas sandstone cobbles and stones have been dislodged by tillage equipment and are on the surface. In these areas the surface layer is light in color and calcareous.

Included with these soils in mapping are small areas of Alliance, Rosebud, and Satanta soils. The included soils have more clay in the profile than the Oglala soil and are on similar landscapes. Rosebud soils are moderately deep over calcareous sandstone. Satanta soils do not have bedrock within a depth of 60 inches. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Oglala and Canyon soils. Available water capacity is moderate in the Oglala soil and very low in the Canyon soil. The organic matter content is moderate in the Oglala soil and moderately low in the Canyon soil. Runoff is medium. The water intake rate is moderate. Root development is restricted by the underlying sandstone in the Canyon soil.

Most of these soils support native grasses and are used as range (fig. 13). A small acreage is used as cropland.

If dryland farmed, the Oglala soil is poorly suited to small grains, alfalfa, and introduced grasses. Inadequate rainfall in summer generally limits the cultivated crops that can be grown. Water erosion and soil blowing are the principal hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to control soil blowing and water erosion and conserve soil moisture. Stripcropping, terraces, and annual cover crops also help to control soil blowing and water erosion. Summer fallowing conserves moisture for use during the following growing season. Terraces are generally difficult to construct because of the irregular topography and the shallow depth to bedrock in areas of the Canyon soil.

If irrigated by a sprinkler system, the Oglala soil is poorly suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. Water erosion and soil blowing are the principal hazards on the slopes. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control erosion and conserve soil moisture. The use of winter cover crops also helps to control soil blowing. Incorporating crop residue and green manure crops into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone and result in the hazard of water erosion on these slopes.

The Canyon soil is not suited to dryland farming or irrigation because of the shallow depth to bedrock.

These soils are poorly suited to introduced grasses used as pasture and hayland. These grasses can be rotated with other crops on the Oglala soil. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. This soil is subject to water erosion. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Continuous heavy grazing and improper haying also reduce the amount of protective cover and can result in soil blowing and the formation of small gullies and rills after heavy rains. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

If these soils are used for range or native hay, the climax vegetation on the Oglala soil is dominantly blue grama, sideoats grama, and western wheatgrass. These species make up 60 percent or more of the total annual forage. Buffalograss, needleandthread, prairie junegrass, Scribner panicum, sedges, and forbs make up the rest. The climax vegetation on the Canyon soil is dominantly little bluestem, sideoats grama, blue grama, hairy grama, big bluestem, and threadleaf sedge. These species make up 70 percent or more of the total annual forage. Prairie sandreed, needleandthread, green needlegrass, and forbs make up the rest. If subject to continuous heavy grazing, big bluestem, little bluestem, prairie junegrass, and switchgrass decrease in abundance on the Oglala soil and little bluestem and big bluestem decrease in abundance on the Canyon soil. They are replaced by blue grama, buffalograss, needleandthread, plains

Figure 13.—A typical area of Oglala-Canyon complex, 6 to 11 percent slopes, that supports native grasses and is used for grazing.

muhly, sand dropseed, tall dropseed, western wheatgrass, and forbs on the Oglala soil and sideoats grama, blue grama, hairy grama, prairie sandreed, sand dropseed, threadleaf sedge, and forbs on the Canyon soil. If overgrazing continues for many years, the native grasses on the Oglala soil lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive. Woody plants may invade the site on the Canyon soil.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre on the Oglala soil and 0.5 animal unit month per acre on the Canyon soil. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range. In areas where gullies have formed because of severe water erosion, land shaping or other mechanical practices may be needed to smooth and stabilize the site before it is reseeded. Brush management may be needed in some areas to control the woody plants that invade the site.

The Oglala soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate rainfall and soil erosion are the principal hazards affecting seedlings and young trees. Seedlings can survive and grow if competing vegetation between the tree rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide. Planting an annual cover crop between the rows helps to control soil blowing. Irrigation can provide supplemental moisture during periods of low rainfall. The Canyon soil generally is not suited to the trees and shrubs planted in windbreaks because of the shallow depth to bedrock. A few areas may be suitable for the trees or shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

In areas of the Oglala soil, mounding the sites for

septic tank absorption fields with several feet of suitable fill material improves the filtering capacity of the soil. The moderate permeability of this soil is also a limitation affecting septic tank absorption fields, but increasing the size of the absorption field can generally overcome this limitation. Land shaping and installing the absorption field on the contour are generally necessary for its proper operation. The Canyon soil is generally not suited to sanitary facilities because of the shallow depth to bedrock. A suitable alternative site should be selected. Buildings should be designed so that they conform to the natural slope of the land, or the soils should be graded to a suitable gradient. In areas of the Canyon soil, the soft bedrock can be excavated during the construction of dwellings with basements or buildings that have deep foundations. The sides of shallow excavations can cave in unless they are shored. A good surface drainage system can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. Cutting and filling can provide a suitable grade for roads. In areas of the Canyon soil, the soft bedrock can be excavated during the construction of roads. Onsite investigation is needed before any engineering practices are applied.

The land capability units are IVe-1, dryland, and IVe-6, irrigated, for the Oglala soil and VIs-4, dryland, for the Canyon soil. The Oglala soil is in the Silty range site and windbreak suitability group 3. The Canyon soil is in the Shallow Limy range site and windbreak suitability group 10.

OhF—Oglala-Canyon complex, 11 to 30 percent slopes. These moderately steep and steep, well drained soils are on uplands. The Oglala soil is deep, and the Canyon soil is shallow. These soils formed in loamy material weathered from calcareous sandstone. The Oglala soil is on the lower side slopes, and the Canyon soil is on convex ridgetops and the upper side slopes. Areas range from 50 to 1,000 acres in size. They consist of 40 to 55 percent Oglala soil and 30 to 40 percent Canyon soil. These soils are so intermingled or mixed that separating them in mapping is not practical.

Typically, the Oglala soil has a surface layer of grayish brown, friable loam about 8 inches thick. The transitional layer is grayish brown, friable silt loam about 11 inches thick. The underlying material to a depth of 58 inches is light brownish gray, calcareous silt loam in the upper part and light gray, calcareous loam in the lower part. Below a depth of 58 inches is white, calcareous sandstone. In some places the surface layer is very fine sandy loam. In cultivated areas 25 to 50 percent of this soil is eroded. In these areas erosion has removed all or most of the original surface soil, and tillage has mixed the remaining surface soil with the subsoil. In most places the surface layer is light in color and calcareous.

Typically, the surface layer of the Canyon soil is grayish brown, very friable loam about 5 inches thick. The transitional layer is light brownish gray, very friable, calcareous very fine sandy loam about 5 inches thick. The underlying material is light gray, calcareous very fine sandy loam to a depth of 14 inches. Below this to a depth of more than 60 inches is white, calcareous sandstone. In places the surface layer is very fine sandy loam or fine sandy loam. In cultivated areas erosion has removed all or most of the original surface soil, and the thickness of the loamy material over the sandstone bedrock has been reduced. In some areas sandstone cobbles and stones have been dislodged by tillage equipment and are on the surface. In these areas the surface layer is light in color and calcareous.

Included with these soils in mapping are small areas of Alliance and Satanta soils. The included soils have more clay in the profile than the Oglala and Canyon soils. These soils are on similar landscapes as the Oglala soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Oglala and Canyon soils. Available water capacity is moderate in the Oglala soil and very low in the Canyon soil. The organic matter content is moderate in the Oglala soil and moderately low in the Canyon soil. Runoff is rapid. Root development is restricted by the underlying sandstone in the Canyon soil.

Nearly all of the acreage of these soils is used as rangeland.

These soils are not suited to farming because of the steep slope and the shallow root zone of the Canyon soil.

If these soils are used for range or native hay, the climax vegetation on the Oglala soil is dominantly blue grama, sideoats grama, and western wheatgrass. These species make up 60 percent or more of the total annual forage. Buffalograss, needleandthread, prairie junegrass, Scribner panicum, sedges, and forbs make up the rest. The climax vegetation on the Canyon soil is dominantly little bluestem, sideoats grama, blue grama, hairy grama, big bluestem, and threadleaf sedge. These species make up 70 percent or more of the total annual forage. Prairie sandreed, needleandthread, green needlegrass, and forbs make up the rest. If subject to continuous heavy grazing, big bluestem, little bluestem, prairie junegrass, and switchgrass decrease in abundance on the Oglala soil

and little bluestem and big bluestem decrease in abundance on the Canyon soil. They are replaced by blue grama, buffalograss, needleandthread, plains muhly, sand dropseed, tall dropseed, western wheatgrass, and forbs on the Oglala soil and sideoats grama, blue grama, hairy grama, prairie sandreed, sand dropseed, threadleaf sedge, and forbs on the Canyon soil. If overgrazing continues for many years, the native grasses on the Oglala soil lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive. Woody plants may invade the site on the Canyon soil.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre on the Oglala soil and 0.5 animal unit month per acre on the Canyon soil. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range. In areas where gullies have formed because of severe water erosion, land shaping or other mechanical practices may be needed to smooth and stabilize the site before it is reseeded. Brush management may be needed in some areas to control the woody plants that invade the site.

The Oglala soil is generally not suited to the trees and shrubs planted in windbreaks because of the slope. The Canyon soil is not suited because of the shallow depth to bedrock. A few areas of these soils may be suitable for the trees or shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

These soils are generally not suitable for sanitary facilities because of the steep slope and the shallow depth to bedrock in the Canyon soil. In areas of the Oglala soil, dwellings and buildings need to be properly designed so that they conform to the natural slope of the land, or the soil can graded to a suitable gradient. The sides of shallow excavations can cave in unless they are shored. The Canyon soil is not suitable for dwellings and buildings because of the shallow depth to bedrock. In areas of the Oglala soil, cutting and filling generally can provide a suitable grade for roads. In areas of the Canyon soil, the bedrock can be excavated during the construction of roads. Onsite investigation is needed before any engineering practices are applied.

The land capability unit is VIe-1, dryland, for the Oglala soil and VIs-4, dryland, for the Canyon soil. The Oglala soil is in the Silty range site, and the Canyon soil is in the Shallow Limy range site. Both soils are in windbreak suitability group 10.

On—Onita silty clay loam, 0 to 1 percent slopes. This very deep, nearly level, moderately well drained soil is in upland swales. It formed in loamy and clayey sediments. This soil is subject to rare flooding. Areas range from 10 to 200 acres in size.

Typically, the surface layer is dark gray, friable silty clay loam about 8 inches thick. The subsoil is about 43 inches thick. The upper part is very dark gray and dark gray, firm silty clay. The lower part is grayish brown, friable, calcareous silt loam. The underlying material is light brownish gray, calcareous silt loam to a depth of more than 60 inches. In some places the surface layer is silt loam or loam.

Included with this soil in mapping are small areas of Lodgepole soils, which are somewhat poorly drained and are in depressions that are ponded for short periods. Also included are some areas that have a perched water table within a depth of 3 feet during wet periods. Included soils make up about 5 to 15 percent of the unit.

Permeability is slow in the Onita soil. Available water capacity is high, but moisture is released slowly to plants. The organic matter content is moderate. Runoff is slow. This soil has a perched water table that ranges from a depth of 3 to 6 feet in most years. The water intake rate is low.

All of the acreage of this soil is cultivated. Some of the acreage is irrigated.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. This soil dries out slowly in the spring. The surface layer is often saturated in some of the low lying areas or swales in the spring and during wet periods. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Soil blowing is a slight hazard if the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to conserve soil moisture and control soil blowing. Returning crop residue to the soil helps to maintain the organic matter content and fertility and improves the water intake rate.

If irrigated, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. It is suited to sprinkler and gravity irrigation systems. Some land leveling is generally needed for gravity systems to ensure the uniform distribution of water. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil

moisture. Incorporating crop residue into the soil helps to maintain the organic matter content and fertility. All irrigation systems need to be designed so that the water application rate does not exceed the low intake rate of this soil. A tailwater recovery system can be used to conserve water.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants is effective in controlling soil blowing. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain the native plants in good condition.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall is the principal hazard affecting seedlings and young trees. Seedlings can survive and grow if competing vegetation between the tree rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide. Planting an annual cover crop between the tree rows helps to control soil blowing. Irrigation can provide supplemental moisture during periods of low rainfall.

The hazard of rare flooding needs to be considered if this soil is used for sanitary facilities and building sites. Because of the slow permeability, this soil is not suited to septic tank absorption fields. Enlarging the field or installing an alternative system is necessary for its proper operation. Strengthening the foundations for dwellings without basements and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil material. Coarser grained subgrade or base material can be used to ensure better performance. A good surface drainage system can minimize the damage to roads and streets caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. Mixing the base material with additives, such as hydrated lime, help to prevent shrinking and swelling.

The land capability units are IIs-2, dryland, and IIs-3, irrigated; Clayey range site; and windbreak suitability group 1.

OrF—Orella silty clay loam, 3 to 30 percent slopes. This shallow, gently sloping to steep, well drained soil is on uplands. It formed in material weathered from shale. Areas range from 20 to 100 acres in size.

Typically, the surface layer is dark grayish brown, firm silty clay loam about 5 inches thick. The transitional layer is light brownish gray, firm, calcareous silty clay loam about 5 inches thick. The underlying material is light gray, calcareous silty clay loam to a depth of 16 inches. Below this to a depth of more than 60 inches is light gray shale. In some places the surface layer is clay loam or silty clay. In other places the transitional layer and underlying material are silty clay or clay.

Included with this soil in mapping are small areas of Bufton and Minnequa soils and areas of Badland. Bufton soils are very deep and are on similar landscapes as the Orella soil. Minnequa soils are moderately deep and formed in material weathered from interbedded chalk and shale. These soils are lower on the landscape than the Orella soil. The areas of Badland are exposed shales and siltstones that are barren and eroded. Included areas make up 5 to 20 percent of the unit.

Permeability is very slow in the Orella soil. Available water capacity is very low. The organic matter content is low. Runoff is rapid.

All of the acreage of this soil supports native grasses and is used for range. This soil is not suited to farming or the trees and shrubs planted in windbreaks because of the high content of sodium and other salts and the shallow depth to shale.

If this soil is used as range, the climax vegetation is dominantly blue grama, buffalograss, inland saltgrass, and western wheatgrass. These species make up 75 percent or more of the total annual production. Sideoats grama, alkali sacaton, grasslike plants, and

forbs make up the rest. If subject to continuous heavy grazing, alkali sacaton and western wheatgrass decrease in abundance.

If the range is in excellent condition, the suggested initial stocking rate is 0.3 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing helps to maintain or improve the range condition. Livestock tend to overuse areas near watering and salting facilities. The areas away from the watering facilities may be underused. Properly locating fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Locating the salting facilities away from the watering facilities and relocating them each time that salt is provided helps to prevent excessive trampling and overuse. Careful management is needed to maintain the plant cover. Proper grazing use is effective in controlling soil blowing and water erosion. The high content of sodium influences the kind of plants that grow and limits forage production on this soil.

This soil is not suited to sanitary facilities because of the steep slope and the depth to shale. A suitable alternative site should be selected. The soft bedrock can be excavated during the construction of dwellings with basements or buildings that have deep foundations. Strengthening the foundations of buildings and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. Foundations also need to be properly designed so that they conform to the natural slope of the land, or the soil can be graded to a suitable gradient. The soft bedrock can be excavated during the construction of roads. Cutting and filling generally can provide a suitable grade for roads. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance. Mixing the base material with additives, such as hydrated lime, helps to prevent excessive shrinking and swelling.

The land capability unit is VIs-4, dryland; Saline Upland range site; and windbreak suitability group 10.

OvD—Orpha loamy fine sand, 3 to 9 percent slopes. This very deep, gently sloping and strongly sloping, excessively drained soil is on foot slopes along the Niobrara River and its tributaries. It formed in sandy material weathered from sandstone. Areas range from 10 to 100 acres in size.

Typically, the surface layer is grayish brown, very friable loamy fine sand about 6 inches thick. The transitional layer is light brownish gray, loose fine sand about 6 inches thick. The underlying material extends to a depth of more than 60 inches. It is light brownish gray fine sand in the upper part and white, calcareous fine sand in the lower part. Sandstone gravel is in the underlying material. In a few places this soil is very gently sloping. In a few areas the surface layer is loamy sand or sand.

Included with this soil in mapping are small areas of Dailey, Niobrara, and Valent soils. Dailey soils have a dark surface soil more than 10 inches thick and are lower on the landscape than the Orpha soil. Niobrara soils are shallow over sandstone and are higher on the landscape than the Orpha soil. Valent soils formed in eolian sand and are higher on the landscape than the Orpha soil. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Orpha soil, and available water capacity is low. The organic matter content is low. Runoff is slow. The water intake rate is very high.

Most of the acreage of this soil supports range and is used for grazing. Some areas are used as hayland.

This soil is not suited to dryland farming because it is too droughty and soil blowing is a severe hazard.

If irrigated by a sprinkler system, this soil is poorly suited to corn, alfalfa, and introduced grasses. It is too sandy for gravity irrigation systems. Light, frequent applications of irrigation water are needed because of the low available water capacity of this soil. Soil blowing is a severe hazard in areas where the surface is not protected by crops or crop residue. Establishing crops is a concern because of the hazard of soil blowing. The use of close-growing crops, a system of conservation tillage that keeps crop residue on the surface, and the use of cover crops during the winter help to control soil blowing. Incorporating crop residue into the soil improves the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone.

If this soil is used as range or hayland, the climax vegetation is dominantly sand bluestem, little bluestem, prairie sandreed, and needleandthread. These species make up 75 percent or more of the total annual forage. Blue grama, switchgrass, sand lovegrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, sand lovegrass, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, blue grama, sand dropseed, sedges, and forbs. If heavy grazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, soil blowing is excessive and blowouts can form.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A

planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy.

This soil is suited to the trees and shrubs planted in windbreaks. Soil blowing is a severe hazard affecting the establishment of windbreaks. It can be controlled by planting the seedlings in a shallow furrow with as little disturbance of the soil as possible. Strips of sod or cover crops also need to be maintained between the tree rows. Insufficient rainfall in summer is another limitation affecting the survival of young trees. Irrigation can provide supplemental moisture during periods of low rainfall. The weeds and undesirable grasses in the tree rows can be controlled by careful use of the appropriate kind of herbicide or by hoeing by hand.

This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. This soil is generally suited to dwellings and roads. Buildings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. The sides of shallow excavations can cave in unless they are shored. Seeding the roadside after construction helps to stabilize the loose soil.

The land capability units are VIe-5, dryland, and IVe-11, irrigated; Sands range site; and windbreak suitability group 7.

OwF—Orpha-Niobrara complex, 9 to 30 percent slopes. These strongly sloping to steep, excessively drained soils are on valley side slopes along the Niobrara River and its tributaries. The Orpha soil is very deep, and the Niobrara soil is shallow. These soils formed in sandy material weathered from sandstone. Areas range from 100 to 1,000 acres in size. They are 55 to 75 percent Orpha soil and 25 to 45 percent Niobrara soil. They are so intermingled or mixed that separating them in mapping is not practical.

Typically, the Orpha soil has a surface layer of grayish brown, loose loamy fine sand about 6 inches thick. The transitional layer is light brownish gray, loose fine sand about 5 inches thick. The underlying material extends to a depth of more than 60 inches. It is pale brown fine sand in the upper part and pale brown, calcareous fine sand in the lower part. Sandstone gravel are throughout the profile. In places the surface layer is loamy sand or sand. In some areas the profile is calcareous throughout.

Typically, the Niobrara soil has a surface layer of light brownish gray, very friable, calcareous loamy fine sand about 4 inches thick. The underlying material to a depth of 13 inches is light brownish gray, calcareous fine sand. Below this to a depth of more than 60 inches is white, calcareous sandstone. In places the surface layer is fine sandy loam or fine sand.

Included soils make up 5 to 25 percent of the unit.

Permeability is rapid in the Orpha and Niobrara soils. Available water capacity is low in the Orpha soil and very low in the Niobrara soil. The organic matter content is low in both soils. Runoff is slow and medium.

All of the acreage of these soils is used for range.

These soils are too steep and droughty for use as cropland. The Niobrara soil is also shallow to bedrock. Soil blowing is a severe hazard.

If these soils are used for range or native hay, the climax vegetation on the Orpha soil is dominantly prairie sandreed, sand bluestem, needleandthread, and little bluestem. These species make up 75 percent or more of the total annual forage. Blue grama, switchgrass, sand lovegrass, sedges, and forbs make up the rest. The climax vegetation on the Niobrara soil is dominantly prairie sandreed, sand bluestem, needleandthread, and little bluestem. These species make up 75 percent or more of the total annual forage. Blue grama, switchgrass, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, sand lovegrass, little bluestem, and switchgrass decrease in abundance on the Orpha soil and little bluestem and switchgrass decrease in abundance on the Niobrara soil. They are replaced by needleandthread, blue grama, sand dropseed, sedges, and forbs on the Orpha soil and sideoats grama, blue grama, hairy grama, prairie sandreed, sand dropseed, threadleaf sedge, and forbs on the Niobrara soil. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, soil blowing is excessive and small blowouts can form. Woody plants may invade the site on the Niobrara soil.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre on the Orpha soil and 0.5 animal unit month per acre on the Niobrara soil. The stocking rate is determined by the percentage of each soil in the pasture. The

range should be closely monitored during use and the stocking rates adjusted so that one soil does not become overgrazed. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Brush management may be needed in some areas to control the woody plants that invade the site. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

These soils are generally not suited to the trees and shrubs planted in windbreaks because of the slope and the shallow depth to bedrock in the Niobrara soil. A few areas may be suitable for the trees and shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

These soils are generally not suited to sanitary facilities because of the slope and the poor filtering capacity in areas of the Orpha soil and the shallow depth to bedrock in areas of the Niobrara soil. A suitable alternative site should be selected. Dwellings and buildings need to be properly designed so that they conform to the natural slope of the land, or the soils can be graded to a suitable gradient. In areas of the Niobrara soil, the soft bedrock can be excavated during the construction of dwellings with basements or buildings that have deep foundations. The sides of shallow excavations in this soil can cave in unless they are shored. Cutting and filling generally can provide a suitable grade for roads. The soft bedrock can be excavated during the construction of roads in areas of the Niobrara soil. Onsite investigation is needed before any engineering practices are applied.

The land capability unit is VIe-5, dryland, for the Orpha soil and VIs-4, dryland, for the Niobrara soil. The Orpha soil is in the Sands range site, and the Niobrara soil is in the Shallow Limy range site. Both soils are in windbreak suitability group 10.

OxG—Orpha-Rock outcrop complex, 20 to 60 percent slopes. This complex consists of the steep and very steep, excessively drained Orpha soil and areas of Rock outcrop. It is along the breaks to the Niobrara River and its tributaries. The Orpha soil is very deep and formed in sandy material weathered from sandstone. It is dominantly on the mid and lower side slopes. The areas of Rock outcrop are on ridges, knolls, and the upper side slopes. Areas range from 100 to 1,000 acres in size. They consist of 60 to 85 percent Orpha soil and 10 to 20 percent areas of Rock outcrop. These areas are so intermingled or mixed that separating them in mapping is not practical.

Typically, the Orpha soil has a surface layer of grayish brown, very friable loamy fine sand about 6 inches thick. The transitional layer is light brownish gray, loose sand about 4 inches thick. The underlying material is light gray sand and fine sand to a depth of 60 inches or more. The lower part is calcareous. Sandstone gravel is throughout the underlying material. In some places the surface layer is loamy sand. In other places the surface layer is dark and more than 10 inches thick. In a few areas the profile is calcareous throughout. In other places calcareous sandstone is within a depth of 60 inches.

Typically, the areas of Rock outcrop consist of light gray and white, calcareous sandstone. In some places soil material that is 1 to 10 inches thick is on the sandstone.

Included with this unit in mapping are small areas of Niobrara soils, which have sandstone at a depth of 10 to 20 inches and are on similar landscapes as the Orpha soil and the areas of Rock outcrop. Also included are areas that have strata of very gravelly sand to very gravelly fine sandy loam in the profile. Included areas make up 10 to 25 percent of the unit.

Permeability is rapid in the Orpha soil, and available water capacity is low. The organic matter content is low. Runoff is medium.

All of the acreage in this map unit is used for range. Ponderosa pine is in some areas along the Niobrara River. Stands of deciduous trees are along some of the other streams and drainageways.

This map unit is not suited to farming because of the steep slope and the areas of Rock outcrop.

If this map unit is used for range, the climax vegetation on the Orpha soil is dominantly sand bluestem, little bluestem, prairie sandreed, and needleandthread. These species make up 75 percent or more of the total annual forage. Blue grama, switchgrass, sand lovegrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, sand lovegrass, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, blue grama, sand dropseed, sedges, and forbs. If heavy grazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, soil blowing is excessive and blowouts can form.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition.

Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. The slope can hinder the movement of livestock. Brush management may be needed in some areas to control the woody plants that invade the site.

The Orpha soil generally is not suited to the trees and shrubs planted in windbreaks because of the steep and very steep slopes and the rock outcrop. A few areas may be suitable for the trees and shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

The Orpha soil is generally not suitable for sanitary facilities because of the slope and the areas of Rock outcrop. A suitable alternative site should be selected. Dwellings and buildings need to be properly designed so that they conform to the natural slope of the land. Also, the bedrock can be excavated during the construction of dwellings with basements or buildings that have deep foundations in the areas of Rock outcrop. The sides of shallow excavations in the Orpha soil can cave in unless they are shored. Cutting and filling generally can provide a suitable grade for roads. The bedrock can be excavated during the construction of roads in the areas of Rock outcrop.

The land capability unit is VIIe-5, dryland, for the Orpha soil and VIIIs-8, dryland, for the areas of Rock outcrop. The Orpha soil is in the Sands range site. No range site is assigned to the areas of Rock outcrop. The Orpha soil and the areas of Rock outcrop are in windbreak suitability group 10.

PoC—Ponderosa very fine sandy loam, 3 to 6 percent slopes. This very deep, gently sloping, well drained soil is on foot slopes in the Pine Ridge. It formed in sandy and loamy sediments weathered from calcareous sandstone. Areas range from 5 to 100 acres in size.

Typically, the surface layer is grayish brown, very friable very fine sandy loam about 8 inches thick. The subsurface layer is also grayish brown, very friable very fine sandy loam about 10 inches thick. The transitional layer is light brownish gray, very friable very fine sandy loam about 12 inches thick. The underlying material is very pale brown, calcareous very fine sandy loam and loamy very fine sand to a depth of 60 inches or more. In some places the surface layer is loamy very fine sand. In other places carbonates are within a depth of 15 inches.

Included with this soil in mapping are small areas of Bridget soils, which have less sand than the Ponderosa soil and are lower on the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Ponderosa soil, and available water capacity is high. The organic matter content is moderately low. Runoff is medium. The water intake rate is moderately high.

Most of the acreage of this soil is used as range. Some areas are used as cropland.

If dryland farmed, this soil is suited to small grains, alfalfa, and introduced grasses. Inadequate rainfall in summer generally limits the cultivated crops that can be grown. Water erosion and soil blowing are hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to control soil blowing and water erosion and conserve soil moisture. Stripcropping, terraces, and annual cover crops help to control erosion. Summer fallowing conserves moisture for use during the following growing season.

If irrigated, this soil is suited to small grains, alfalfa, and introduced grasses. It is best suited to sprinkler irrigation systems because of the moderately high water intake rate. Extensive land leveling is generally needed if gravity systems are used to ensure the uniform distribution of water; however, care should be taken not to expose the sandy underlying material. Soil blowing and water erosion are the principal hazards. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. The use of winter cover crops also helps to control soil blowing. Incorporating crop residue and green manure crops into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone and result in the hazard of water erosion on these slopes.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Continuous heavy grazing and improper haying also reduce the protective cover and can result in soil blowing and the formation of small gullies and rills after heavy rains. Managing separate pastures of cool- and warm-season grasses can extend the grazing

season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing and water erosion. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. As a result, soil blowing and water erosion are excessive. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants. Range seeding may be needed to stabilize severely eroded areas of cropland.

This soil is suited to the trees and shrubs planted in windbreaks. Soil blowing and water erosion are hazards. Erosion can be controlled by maintaining strips of sod or a cover crop between the tree rows. The weeds and undesirable grasses in the rows can be controlled by careful use of the appropriate kind of herbicide or by hoeing by hand. Cultivation between the tree rows with conventional equipment can control undesirable grasses and weeds in areas where strips of sod and cover crops are not used. The lack of adequate rainfall in summer is also a hazard affecting the survival of young trees. Irrigation can provide supplemental moisture during periods of low rainfall.

This soil is generally suitable for septic tank absorption fields and roads. Buildings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. The sides of shallow excavations can cave in unless they are shored.

The land capability units are IIIe-3, dryland, and IIIe-8, irrigated; Sandy range site; and windbreak suitability group 5.

PoD—Ponderosa very fine sandy loam, 6 to 9 percent slopes. This very deep, strongly sloping, well drained soil is on valley sides and foot slopes in the Pine Ridge. It formed in sandy and loamy sediments weathered from calcareous sandstone. Areas range from 10 to 200 acres in size.

Typically, the surface layer is dark grayish brown, very friable very fine sandy loam about 5 inches thick. The subsurface layer is dark gray, very friable very fine sandy loam about 5 inches thick. The transitional layer is grayish brown, very friable very fine sandy loam about 7 inches thick. The underlying material to a depth of more than 60 inches is loamy very fine sand. The upper part is light brownish gray, and the lower part is light gray and calcareous. In some places the dark surface soil is more than 20 inches thick. In other places the carbonates are within a depth of 15 inches.

Included with this soil in mapping are small areas of Bridget and Tassel soils. Bridget soils have less sand than the Ponderosa soil and are lower on the landscape. Tassel soils are shallow over sandstone and are higher on the landscape than the Ponderosa soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Ponderosa soil, and available water capacity is high. The organic matter content is moderately low. Runoff is medium. The water intake rate is moderately high.

Most of the acreage of this soil supports range. Some areas are used as cropland.

If dryland farmed, this soil is poorly suited to small grains, alfalfa, and introduced grasses. Inadequate rainfall in summer generally limits the crops that can be grown. Water erosion and soil blowing are hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and stripcropping, helps to control soil blowing and water erosion and conserve soil moisture. Incorporating crop residue into the soil helps improve the organic matter content and fertility.

If irrigated by a sprinkler system, this soil is poorly suited to corn, small grains, alfalfa, and introduced grasses. It is too steep for gravity irrigation systems. This soil is best suited to sprinkler systems because of the moderately high water intake rate and the strong slope. Soil blowing and water erosion are severe hazards in areas where the surface is not protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and no-till, that keeps crop residue on the surface helps to control erosion and conserve moisture. Returning crop residue and green manure crops to the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water result in the hazard of water erosion on these slopes and leach plant nutrients below the root zone.

If this soil is used for range or native hay, the climax vegetation is dominantly prairie sandreed, sand bluestem, needleandthread, and little bluestem. These species make up 65 percent or more of the total annual forage. Blue grama, switchgrass, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, prairie sandreed, blue grama, Scribner panicum, sand dropseed, and forbs. If heavy

grazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

This soil is suited to the trees and shrubs planted in windbreaks. Water erosion and soil blowing are hazards. Erosion can be controlled by maintaining strips of sod or a cover crop between the tree rows. The weeds and undesirable grasses in the rows can be controlled by careful use of the appropriate kind of herbicide or by hoeing by hand. Irrigation can provide supplemental moisture during periods of low rainfall.

This soil is generally suited to sites for septic tank absorption fields and roads and streets. Dwellings and buildings need to be properly designed so that they conform to the natural slope of the land, or the soil can be graded to a suitable gradient. The sides of shallow excavations can cave in unless they are shored.

The land capability units are IVe-3, dryland, and IVe-8, irrigated; Sandy range site; and windbreak suitability group 5.

PtF—Ponderosa-Tassel-Vetal complex, 6 to 30 percent slopes. These strongly sloping to steep, well drained soils are in the Pine Ridge. They formed in loamy and sandy sediments mainly weathered from sandstone. The very deep Ponderosa soil is on the middle and lower side slopes. The shallow Tassel soil is on ridgetops and the steep upper side slopes. The very deep Vetal soil is on foot slopes and in swales. Areas range from 20 to 500 acres in size. They consist of 20 to 35 percent Ponderosa soil, 15 to 30 percent Tassel soil, 15 to 25 percent Vetal soil, and 25 to 35 percent included soils. They are so intermingled or mixed that separating them in mapping is not practical.

Typically, the Ponderosa soil has a surface layer of grayish brown, very friable very fine sandy loam about 12 inches thick. The transitional layer is pale brown, very friable very fine sandy loam about 9 inches thick. The underlying material extends to a depth of more than 60 inches. It is light brownish gray very fine sandy loam in the upper part and very pale brown, calcareous loamy very fine sand in the lower part. The profile contains less than 15 percent, by volume, sandstone gravel. In some places the surface layer is loamy very fine sand. In other places calcareous sandstone is at a depth of 40 to 60 inches. In some areas carbonates are at the surface.

Typically, the Tassel soil has a surface layer of grayish brown, very friable, calcareous very fine sandy loam about 3 inches thick. The transitional layer is grayish brown, very friable, calcareous very fine sandy loam about 3 inches thick. The underlying material is pale brown, calcareous very fine sandy loam to a depth of 15 inches. Below this to a depth of more than 60 inches is white, calcareous sandstone. In some places the solum is fine sandy loam or loam.

Typically, the Vetal soil has a surface layer of dark gray, very friable very fine sandy loam about 7 inches thick. The subsurface layer is dark gray, very friable fine sandy loam about 10 inches thick. The transitional layer is very friable fine sandy loam about 25 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The underlying material is light gray, calcareous fine sand to a depth of 60 inches or more.

Included with these soils in mapping are small areas of Bridget, Busher, and Oglala soils and areas of rock outcrop. Bridget and Oglala soils have more silt and less sand than the Ponderosa, Tassel, and Vetal soils. Bridget soils are on the lower side slopes and toeslopes. Oglala and Busher soils have sandstone at a depth of 40 to 60 inches and are on similar landscapes as the Ponderosa, Tassel, and Vetal soils. The areas of rock outcrop are on ridgetops and steep side slopes. Included soils make up 5 to 25 percent of the unit.

Permeability is moderately rapid in the Ponderosa, Tassel, and Vetal soils. Available water capacity is high in the Ponderosa and Vetal soils and very low in the Tassel soil. The organic matter content is moderately low in all three soils. Runoff is medium and rapid.

Nearly all of the acreage of this complex supports native grasses and is used as range. A few areas that were previously used as cropland have been reseeded to grasses.

These soils are generally not suited to cultivation because of the steep slope and the shallow depth to bedrock in the Tassel soil. Onsite investigation may identify small, isolated areas on the lesser slopes that are suited to alfalfa or small grains.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre on the Ponderosa and Vetal soils and 0.5 animal unit month per acre on the Tassel soil. The stocking rate is determined by the percentage of each soil in the pasture. The range should be closely monitored during use and the stocking rates adjusted so that one soil does not become overgrazed. A planned grazing system that includes proper grazing use and timely

deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Brush management may be needed in some areas to control the woody plants that invade the site. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If these soils are used for range or as hayland, the climax vegetation on the Ponderosa soil is dominantly little bluestem, sand bluestem, needleandthread, and switchgrass. These species make up 65 percent or more of the total annual forage. Blue grama, green needlegrass, prairie sandreed, bluegrass, and forbs make up the rest. The climax vegetation on the Tassel soil is dominantly little bluestem, blue grama, needleandthread, and sand bluestem. These species make up 75 percent or more of the total annual forage. Prairie sandreed, threadleaf sedge, and forbs make up the rest. The climax vegetation on the Vetal soil is dominantly prairie sandreed, little bluestem, switchgrass, needleandthread, and sand bluestem. These species make up 75 percent or more of the total annual forage. Blue grama, western wheatgrass, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, little bluestem, and switchgrass decrease in abundance on the Ponderosa soil, little bluestem and sand bluestem decrease in abundance on the Tassel soil, and little bluestem, switchgrass, and sand bluestem decrease in abundance on the Vetal soil. They are replaced by needleandthread, blue grama, Scribner panicum, sand dropseed, and forbs on the Ponderosa and Vetal soils and sideoats grama, blue grama, hairy grama, prairie sandreed, sand dropseed, threadleaf sedge, and forbs on the Tassel soil. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive. Woody plants may invade the site on the Tassel soil.

The areas of the Ponderosa and Tassel soils in this complex are generally not suited to the trees and shrubs planted in windbreaks because of the steep slope and the shallow depth to bedrock in areas of the Tassel soil. These areas can be used for the trees and shrubs that enhance recreational areas and wildlife habitat or for forestation if they are planted by hand or if other approved special management is used. The Vetal soil is suited to the trees and shrubs planted in windbreaks. Soil blowing can be controlled by maintaining strips of sod or cover crops between the tree rows. Supplemental water may be needed during dry periods. The weeds and undesirable grasses in the tree rows can be controlled by proper applications of the appropriate kind of herbicide or by hoeing by hand.

The Ponderosa and Tassel soils are generally not suitable for sanitary facilities because of the strongly sloping and steep slopes and the shallow depth to bedrock in areas of the Tassel soil. In areas of the Vetal soil, land shaping and installing the absorption field on the contour helps to ensure that the system operates properly. Dwellings need to be properly designed so that they conform to the natural slope of the land, or the soil can be graded to a suitable gradient. In areas of the Tassel soil, the soft bedrock can be excavated during the construction of dwellings with basements or buildings that have deep foundations. The sides of shallow excavations in the Ponderosa and Vetal soils can cave in unless they are shored. Cutting and filling generally can provide a suitable grade for roads. The soft bedrock can be excavated during the construction of roads in areas of the Tassel soil. In areas of the Vetal soil a good surface drainage system can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. Onsite investigation is needed before any engineering practices are applied.

The land capability unit is VIe-3, dryland, for the Ponderosa and Vetal soils and VIs-4, dryland, for the Tassel soil. The Ponderosa and Vetal soils are in the Sandy range site, and the Tassel soil is in the Shallow Limy range site. The Ponderosa and Tassel soils are in windbreak suitability group 10. The Vetal soil is in windbreak suitability group 5.

RoB—Rosebud loam, 1 to 3 percent slopes. This moderately deep, very gently sloping, well drained soil is on uplands. It formed in loamy material weathered from calcareous sandstone. Areas range from 5 to 200 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 9 inches thick. The subsoil is about 12 inches thick. The upper part is grayish brown, firm clay loam, and the lower part is very pale brown, very friable, calcareous loam. The underlying material is very pale brown, calcareous loam to a depth of 32 inches. Below this to a depth of more than 60 inches is white, calcareous sandstone. In some places the surface layer is silt loam. In other places the subsoil is silty clay loam or sandy clay loam.

Included with this soil in mapping are small areas of Alliance, Canyon, Duroc, and Oglala soils. Alliance soils have sandstone at a depth of 40 to 60 inches and are on similar landscapes as the Rosebud soil. Canyon soils have sandstone at a depth of 6 to 20

inches and are higher on the landscape than the Rosebud soil. Duroc soils are very deep and have a dark surface soil more than 20 inches thick. These soils are lower on the landscape than the Rosebud soil. Oglala soils have less clay in the profile than the Rosebud soil and have sandstone at a depth of 40 to 60 inches. These soils are on similar landscapes. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Rosebud soil, and available water capacity is low. The organic matter content is moderate. Runoff is slow. The water intake rate is moderate.

Most of the acreage of this soil is dryland farmed. Some areas are irrigated. A few areas support native grasses and are used for grazing.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Soil blowing and water erosion are slight hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to control soil blowing and water erosion and conserve soil moisture. Returning crop residue to the soil helps to maintain the organic matter content and fertility and improve the water intake rate.

If irrigated, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. It is suited to sprinkler and gravity irrigation systems. Some land leveling is generally needed for gravity systems to ensure the uniform distribution of water. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and water erosion and conserve soil moisture. The use of winter cover crops also helps to control soil blowing. Incorporating crop residue into the soil helps to maintain the organic matter content and fertility. Irrigation systems need to be designed so that the water application rate does not exceed the moderate intake rate of this soil. A tailwater recovery system can be used to conserve water.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants very effectively controls soil blowing. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants.

This soil is suited to the trees and shrubs planted in windbreaks. The limited rooting depth of this soil and the lack of seasonal rainfall are the main concerns. Soil blowing and water erosion are slight hazards. Irrigation can provide supplemental moisture during periods of low rainfall. Seedlings can survive and grow if competing vegetation between the tree rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

The use of this soil for septic tank absorption fields is limited by depth to bedrock. Mounding the site with several feet of suitable fill material improves the filtering capacity of the soil. This soil is generally suited to sites for dwellings without basements. The soft bedrock can be excavated during the construction of dwellings with basements or buildings that have deep foundations. A good surface drainage system can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

The land capability units are IIIe-1, dryland, and IIIe-4, irrigated; Silty range site; and windbreak suitability group 6R.

SnB—Satanta fine sandy loam, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, well drained soil is on uplands. It formed in loamy eolian material. Areas range from 5 to 140 acres in size.

Typically, the surface layer is dark grayish brown, very friable fine sandy loam about 9 inches thick. The subsurface layer is dark grayish brown, very friable fine sandy loam about 5 inches thick. The subsoil is

about 21 inches thick. The upper part is grayish brown and pale brown, firm sandy clay loam, and the lower part is light gray, friable, calcareous loam. The underlying material is light gray, calcareous very fine sandy loam and fine sandy loam to a depth of 60 inches or more. In some places the surface layer is loamy sand. In places the dark surface soil is more than 20 inches thick. In a few areas calcareous sandstone or fine sand is below a depth of 40 inches.

Included with this soil in mapping are small areas of Busher, Dailey, and Jayem soils. The included soils have more sand in the profile than the Satanta soil and are on similar landscapes. Busher soils have sandstone at a depth of 40 to 60 inches. Included soils make up 10 to 15 percent of the unit.

Permeability and available water capacity are moderate in the Satanta soil. The organic matter content is moderately low. Runoff is slow. The water intake rate is moderate.

Most of the acreage of this soil is dryland farmed. The rest is used for range.

If dryland farmed, this soil is suited to small grains, alfalfa, and introduced grasses. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Soil blowing and water erosion are slight hazards in areas where the surface is not protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to conserve soil moisture and control erosion. The use of cover crops during the winter also helps to control erosion. Returning crop residue to the soil helps to maintain the organic matter content and fertility and improve the water intake rate.

If irrigated, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. It is suited to sprinkler and gravity irrigation systems. Some land leveling is generally needed for gravity systems to ensure the uniform distribution of water. Soil blowing and water erosion are slight hazards. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and water erosion and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue and green manure crops into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler or gravity systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing and water erosion. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants. Range seeding may be needed to stabilize severely eroded areas of cropland.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate rainfall in summer is a hazard affecting the survival of young trees. Supplemental water can provide needed moisture during dry periods. Soil blowing and water erosion are slight hazards. Erosion can be controlled by maintaining strips of sod or a cover crop between the tree rows. The weeds and undesirable grasses in the rows can be controlled by the careful use of the appropriate kind of herbicide or hoeing by hand. Cultivation with conventional equipment between the tree rows can control the undesirable grasses and weeds in areas where strips of sod and cover crops are not used.

The moderate permeability is a limitation on sites for septic tank absorption fields. Increasing the size of the absorption field can generally overcome this limitation. Strengthening the foundations of buildings and basements and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. The sides of shallow excavations can cave in unless they are shored. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance. Mixing the base material with additives, such as hydrated lime, helps to prevent excessive shrinking and swelling.

The land capability units are IIIe-3, dryland, and IIe-5, irrigated; Silty range site; and windbreak suitability group 5.

SnC—Satanta fine sandy loam, 3 to 6 percent slopes. This very deep, gently sloping, well drained soil is on side slopes and ridges on uplands. It formed in loamy eolian material. Areas range from 5 to 200 acres in size.

Typically, the surface layer is dark grayish brown, very friable fine sandy loam about 9 inches thick. The subsoil is about 29 inches thick. The upper part is dark grayish brown, friable loam; the middle part is grayish brown, firm clay loam; and the lower part is light gray, friable, calcareous loam. The underlying material is light gray, calcareous very fine sandy loam to a depth of 60 inches or more. In cultivated areas 15 to 30 percent of this soil is eroded. In these areas erosion has removed all or most of the original surface soil, and tillage has mixed the remaining surface soil with the subsoil. In some places the surface layer is light in color and calcareous. In other places the surface layer is clay loam. In other places the surface layer is loamy fine sand. In some areas calcareous sandstone or fine sand is below a depth of 40 inches.

Included with this soil in mapping are small areas of Busher, Dailey, and Jayem soils on similar landscapes as the Satanta soil. The included soils have more sand in the profile. Busher soils have sandstone at a depth of 40 to 60 inches. Included soils make up 10 to 15 percent of the unit.

Permeability and available water capacity are moderate in the Satanta soil. The organic matter content is moderately low. Runoff is slow. The water intake rate is moderate.

Most of the acreage of this soil is dryland farmed. A small acreage is irrigated. The rest is used for range.

If dryland farmed, this soil is suited to small grains, alfalfa, and introduced grasses. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Water erosion and soil blowing are hazards in areas where the surface is not protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to conserve soil moisture and control water erosion and soil blowing. The use of winter cover crops helps to control soil blowing. Terraces and contour farming are effective in controlling water erosion and conserving soil moisture. Returning crop residue to the soil helps to maintain the organic matter content and fertility and improve the water intake rate.

If irrigated by a sprinkler system, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. Extensive land leveling is generally needed for gravity irrigation systems on this soil. Water erosion and soil blowing are the principal hazards. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control erosion and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone and result in water erosion on the slopes.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. This soil is subject to water erosion. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Continuous heavy grazing and improper haying also reduces the amount of protective cover and can result in soil blowing and the formation of small gullies and rills after heavy rains. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing and water erosion. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. As a result, soil blowing and water erosion are excessive. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants. Range seeding may be needed to stabilize severely eroded areas of cropland.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate rainfall in summer is a hazard affecting the survival of young trees. Supplemental water can provide needed moisture during dry periods. Soil blowing and water erosion are hazards. Erosion can be controlled by maintaining

strips of sod or a cover crop between the tree rows. Cultivation with conventional equipment between the rows can control undesirable grasses and weeds in areas where strips of sod and cover crops are not used. The weeds and undesirable grasses in the tree rows can be controlled by the careful use of the appropriate kind of herbicide or hoeing by hand.

The moderate permeability is a limitation on sites for septic tank absorption fields. Increasing the size of the absorption field can generally overcome this limitation. Strengthening the foundations of buildings and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. Buildings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. The sides of shallow excavations can cave in unless they are shored. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance. Mixing the base material with additives, such as hydrated lime, helps to prevent excessive shrinking and swelling.

The land capability units are IIIe-3, dryland, and IIIe-5, irrigated; Silty range site; and windbreak suitability group 5.

SnD—Satanta fine sandy loam, 6 to 11 percent slopes. This very deep, strongly sloping, well drained soil is on side slopes and ridges on uplands. It formed in loamy eolian material. Areas range from 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable fine sandy loam about 8 inches thick. The subsurface layer is dark brown, very friable fine sandy loam about 3 inches thick. The subsoil is about 27 inches thick. The upper part is grayish brown, firm clay loam, and the lower part is light gray, friable, calcareous loam. The underlying material is calcareous and extends to a depth of 60 inches or more. It is light gray very fine sandy loam in the upper part and pale brown loamy fine sand in the lower part. In cultivated areas 20 to 35 percent of this soil is eroded. In these areas erosion has removed all or most of the original surface soil, and tillage has mixed the remaining surface soil with the subsoil. In most places the surface layer is light in color and calcareous. In some places the surface layer is clay loam. In a few places the surface layer is loamy fine sand. In some areas calcareous sandstone or fine sand is below a depth of 40 inches.

Included with this soil in mapping are small areas of Busher, Dailey, and Jayem soils. The included soils have more sand in the profile than the Satanta soil and are on similar landscapes. Busher soils have sandstone at a depth of 40 to 60 inches. Included soils make up 10 to 15 percent of the unit.

Permeability and available water capacity are moderate in the Satanta soil. The organic matter content is moderately low. Runoff is medium. The water intake rate is moderate.

Most of the acreage of this soil is used as range. The rest is dryland farmed.

If dryland farmed, this soil is poorly suited to small grains, alfalfa, and introduced grasses. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Water erosion and soil blowing are the principal hazards in areas where the soil surface is not protected by crops or crop residue. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. Stripcropping, terraces, and annual cover crops help to control water erosion and soil blowing. Returning crop residue to the soil improves the organic matter content and fertility.

If irrigated by a sprinkler system, this soil is poorly suited to corn, field beans, small grains, alfalfa, and introduced grasses. It is not suited to gravity irrigation because of the slope. Water erosion and soil blowing are severe hazards in areas where the surface is not protected by crops or crop residue. Wheel-track erosion can be a management concern if a center-pivot irrigation system is used. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control water erosion and soil blowing and conserve soil moisture. Stripcropping, terraces, and annual cover crops also help to control erosion. Returning crop residue to the soil helps improve the organic matter content and fertility. The irrigation system needs to be designed so that the water application rate does not exceed the moderate water intake rate.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be alternated with other crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. This soil is subject to water erosion. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Continuous heavy grazing and improper haying also reduces the amount

of protective cover and can result in soil blowing and the formation of small gullies and rills after heavy rains. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing and water erosion. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. As a result, water erosion and soil blowing are excessive. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants. Range seeding may be needed to stabilize severely eroded areas of cropland.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and soil erosion are the main hazards affecting young trees. Supplemental water can provide needed moisture during dry periods. Water erosion and soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Cultivation with conventional equipment between the rows can control the undesirable grasses and weeds in areas where strips of sod and cover crops are not used. The weeds and undesirable grasses in the tree rows can be controlled by the careful use of the appropriate kind of herbicide or hoeing by hand.

The moderate permeability is a limitation on sites for septic tank absorption fields. Increasing the size of the absorption field can generally overcome this limitation. Land shaping and installing the distribution lines on the contour help to ensure that the absorption field functions properly. Dwellings and buildings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. Strengthening the foundations of buildings and backfilling with coarse material help to prevent the damage caused by shrinking and swelling. The sides of shallow excavations can cave in unless they are shored. Roads built on this soil should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance. Mixing the base material with additives, such as hydrated lime, helps to prevent excessive shrinking and swelling. Cutting and filling can provide a suitable grade for roads.

The land capability units are IVe-3, dryland, and IVe-5, irrigated; Silty range site; and windbreak suitability group 5.

SsD—Satanta-Canyon complex, 6 to 11 percent slopes. These strongly sloping, well drained soils are on uplands. The very deep Satanta soil formed in loamy eolian material, and the shallow Canyon soil formed in loamy material weathered from calcareous sandstone. The Satanta soil is on the mid and lower side slopes. The Canyon soil is on ridgetops and knolls. Areas range from 15 to 700 acres in size. They consist of about 45 to 60 percent Satanta soil and about 25 to 40 percent Canyon soil. These soils are so intermingled or mixed that separating them in mapping is not practical.

Typically, the surface layer of the Satanta soil is dark grayish brown, very friable fine sandy loam about 10 inches thick. The subsoil is about 23 inches thick. It is grayish brown, firm sandy clay loam in the upper part and pale brown, friable, calcareous loam in the lower part. The underlying material is light gray, calcareous very fine sandy loam to a depth of more than 60 inches. In cultivated areas 20 to 35 percent of this soil is eroded. In these areas erosion has removed all or most of the original surface soil, and tillage has mixed the remaining surface soil with the subsoil. In most places the surface layer is light in color and calcareous. In some places the surface layer is sandy clay loam, clay loam, or loam.

Typically, the surface layer of the Canyon soil is dark grayish brown, very friable, calcareous loam about 6 inches thick. The underlying material is light brownish gray, calcareous loam about 8 inches thick. Calcareous sandstone is at a depth of 14 inches. In cultivated areas erosion has removed all or most of the original surface soil, and the thickness of the loamy material over the sandstone bedrock has been reduced. In these areas numerous sandstone fragments have been dislodged by tillage equipment and are on the surface. In these areas the surface layer is light in color and calcareous. In some places the surface layer is very fine sandy loam or fine sandy loam.

Included with these soils in mapping are small areas of Alliance, Duroc, McCook, and Rosebud soils. Alliance soils have less sand than the Satanta and Canyon soils and are on similar landscapes. Duroc soils have a dark surface soil more than 20 inches thick and are in swales. McCook soils are stratified and are on bottom land. Rosebud soils have

sandstone at a depth of 20 to 40 inches and are on knolls and the upper side slopes. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderate in the Satanta and Canyon soils. Available water capacity is moderate in the Satanta soil and very low in the Canyon soil. Organic matter content is moderately low in both soils. Runoff is medium. The water intake rate is moderate in the Satanta soil.

Most of the acreage of these soils is used as rangeland. A small acreage is used for cultivated crops.

The Canyon soil is not suited to cultivated crops because of the shallow depth to bedrock.

If dryland farmed, the Satanta soil is poorly suited to small grains, alfalfa, and introduced grasses. Inadequate rainfall in summer generally limits the cultivated crops that can be grown. Water erosion and soil blowing are hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as ecofallow, no-till, terraces, stripcropping, and annual cover crops, helps to conserve soil moisture and control erosion.

If irrigated by a sprinkler system, the Satanta soil is poorly suited to corn, field beans, small grains, alfalfa, and introduced grasses. This soil is not suited to gravity irrigation because of the slope. Water erosion and soil blowing are the main hazards. The systems of conservation tillage used to control erosion are similar to those in areas used for dryland farming. The irrigation system needs to be designed so that the water application rate does not exceed the moderate water intake rate of the Satanta soil.

These soils are suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. This soil is subject to water erosion. Continuous heavy grazing or improper haying causes poor plant vigor and reduced forage production. Continuous heavy grazing and improper haying also reduces the amount of protective cover and can result in soil blowing and the formation of small gullies and rills after heavy rains. Managing separate pastures of cool- and warm-season grasses can extend the grazing season by supplying spring and fall grazing. Rotation grazing, proper stocking rates, and timely mowing help to maintain high productivity. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be added by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

If these soils are used for range or native hay, the climax vegetation on the Satanta soil is dominantly big bluestem, blue grama, little bluestem, sideoats grama, and western wheatgrass. These species make up 80 percent or more of the total annual forage. Buffalograss, needleandthread, prairie junegrass, Scribner panicum, switchgrass, sedges, and forbs make up the rest. The climax vegetation on the Canyon soil is dominantly little bluestem, sideoats grama, western wheatgrass, blue grama, and threadleaf sedge. These species make up 65 percent or more of the total annual forage. Prairie sandreed, needleandthread, green needlegrass, hairy grama, big bluestem, and forbs make up the rest. If subject to continuous heavy grazing, big bluestem, little bluestem, prairie junegrass, and switchgrass decrease in abundance on the Satanta soil, and little bluestem and big bluestem decrease in abundance on the Canyon soil. They are replaced by blue grama, buffalograss, needleandthread, plains muhly, sand dropseed, tall dropseed, western wheatgrass, and forbs on the Satanta soil and sideoats grama, blue grama, hairy grama, prairie sandreed, sand dropseed, threadleaf sedge, and forbs on the Canyon soil. If overgrazing continues for many years, the native grasses on the Satanta soil lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive. Woody plants may invade the site on the Canyon soil.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre on the Satanta soil and 0.5 animal unit month per acre on the Canyon soil. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded with a suitable grass mixture if they are used as range. In areas where gullies have formed because of severe water erosion, land shaping or other mechanical practices may be needed to smooth and stabilize the site before it is reseeded. Brush management may be needed in some areas to control the woody plants that invade the site.

The Satanta soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and soil erosion are the principal hazards affecting seedlings and young trees. Irrigation can

provide supplemental moisture during periods of low rainfall. Seedlings can survive and grow if competing vegetation between the tree rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide. Planting an annual cover crop between the tree rows helps to control soil blowing. The Canyon soil is generally not suited to the trees and shrubs planted in windbreaks because of the shallow depth to bedrock.

In areas of the Satanta soil, the moderate permeability is a limitation on sites for septic tank absorption fields. Increasing the size of the absorption field can generally overcome this limitation. Land shaping and installing the distribution lines on the contour help to ensure that the absorption field functions properly. Septic tank absorption fields are generally not suited to areas of the Canyon soil because of the shallow depth to bedrock. A suitable alternative site should be selected. In areas of the Satanta soil, strengthening the foundations of buildings and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. The soft bedrock of the Canyon soil generally can be easily excavated during the construction of dwellings with basements or buildings that have deep foundations. Dwellings and buildings on these soils should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. The sides of shallow excavations in the Satanta soil can cave in unless they are shored. Roads built on the Satanta soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Mixing coarser grained base material with additives, such as hydrated lime, helps to prevent excessive shrinking and swelling and ensure better performance. The soft bedrock of the Canyon soil can be excavated during the construction of roads. Cutting and filling can provide a suitable grade for roads. Onsite investigation is needed before any engineering practices are applied.

The land capability units are IVe-3, dryland, and IVe-5, irrigated, for the Satanta soil and VIs-4, dryland, for the Canyon soil. The Satanta soil is in the Silty range site and windbreak suitability group 5. The Canyon soil is in the Shallow Limy range site and windbreak suitability group 10.

SsE—Satanta-Canyon complex, 11 to 20 percent slopes. These moderately steep, well drained soils are on uplands. The very deep Satanta soil formed in loamy eolian material, and the shallow Canyon soil formed in loamy material weathered from calcareous sandstone. The Satanta soil is on the mid and lower side slopes. The Canyon soil is on ridgetops and knolls. Areas range from 10 to 200 acres in size. They consist of about 45 to 60 percent Satanta soil and about 25 to 40 percent Canyon soil. These soils are so intermingled or mixed that separating them in mapping is not practical.

Typically, the surface layer of the Satanta soil is grayish brown, very friable fine sandy loam about 9 inches thick. The subsoil is about 23 inches thick. It is grayish brown, firm clay loam in the upper part and light brownish gray, friable, calcareous loam in the lower part. The underlying material is light gray to a depth of more than 60 inches. It is calcareous fine sandy loam in the upper part and loamy fine sand in the lower part. In some places the surface layer is loam or very fine sandy loam. In cultivated areas 20 to 40 percent of this soil is eroded. In these areas erosion has removed all or most of the original surface soil, and tillage has mixed the remaining surface soil with the subsoil. In most places the surface layer is light in color and calcareous. In some places the surface layer is clay loam. In some areas calcareous sandstone is at a depth of 40 to 60 inches.

Typically, the surface layer of the Canyon soil is dark grayish brown, very friable loam about 6 inches thick. The underlying material is light brownish gray, calcareous loam about 8 inches thick. Calcareous sandstone is at a depth of 14 inches. In cultivated areas erosion has removed all or most of the original surface soil, and the thickness of the loamy material over the sandstone bedrock has been reduced. In these areas numerous sandstone fragments have been dislodged by tillage equipment and are on the surface. In these areas the surface layer is typically light in color and calcareous. In some places the surface layer is very fine sandy loam or fine sandy loam.

Included with these soils in mapping are small areas of Busher and Tassel soils, which contain more sand than the Satanta and Canyon soils. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Satanta and Canyon soils. Available water capacity is moderate in the Satanta soil and very low in the Canyon soil. Organic matter content is moderately low in both soils. Runoff is rapid.

Nearly all of the acreage of these soils supports native grasses and is used for grazing. These soils are not suitable for cropland because of the moderately steep slope.

If these soils are used for range or native hay, the climax vegetation on the Satanta soil is dominantly big

bluestem, blue grama, little bluestem, sideoats grama, and western wheatgrass. These species make up 80 percent or more of the total annual forage. Buffalograss, needleandthread, prairie junegrass, Scribner panicum, switchgrass, sedges, and forbs make up the rest. The climax vegetation on the Canyon soil is dominantly little bluestem, sideoats grama, western wheatgrass, blue grama, hairy grama, big bluestem, and threadleaf sedge. These species make up 65 percent or more of the total annual forage. Prairie sandreed, needleandthread, green needlegrass, hairy grama, big bluestem, and forbs make up the rest. If subject to continuous heavy grazing, big bluestem, little bluestem, prairie junegrass, and switchgrass decrease in abundance on the Satanta soil, and little bluestem and big bluestem decrease in abundance on the Canyon soil. They are replaced by blue grama, buffalograss, needleandthread, plains muhly, sand dropseed, tall dropseed, threadleaf sedge, and forbs on the Canyon soil. If overgrazing continues for many years, the native grasses on the Satanta soil lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive. Woody plants may invade the site on the Canyon soil.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre on the Satanta soil and 0.5 animal unit month per acre on the Canyon soil. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range. In areas where gullies have formed because of severe water erosion, land shaping or other mechanical practices may be needed to smooth and stabilize the site before it is reseeded. Brush management may be needed in some areas to control the woody plants that invade the site.

The Satanta soil is suited to the trees and shrubs planted in windbreaks. The Canyon soil is generally not suited because of the shallow depth to bedrock. The lack of adequate seasonal rainfall and soil erosion are the main hazards on the Satanta soil. Supplemental water can provide needed moisture during dry periods. Seedlings can survive and grow if competing vegetation between the tree rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

These soils generally are not suitable as sites for sanitary facilities because of the slope and the shallow depth to bedrock in the Canyon soil. A suitable alternative site should be selected. Dwellings should be designed so that they conform to the natural slope of the land, or the site should be graded to an acceptable gradient. In areas of the Canyon soil, the soft bedrock generally can be easily excavated during the construction of dwellings with basements or buildings that have deep foundations. In areas of the Satanta soil, strengthening the foundations of buildings and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. The sides of shallow excavations in this soil can cave in unless they are shored. Cutting and filling generally can provide a suitable grade for roads. The soft bedrock can be excavated during the construction of roads in areas of the Canyon soil. Roads built on the Satanta soil should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance. In areas of the Satanta soil, mixing the base material with additives, such as hydrated lime, helps to prevent excessive shrinking and swelling.

The land capability unit is VIe-1, dryland, for the Satanta soil and VIs-4, dryland, for the Canyon soil. The Satanta soil is in the Silty range site and windbreak suitability group 5. The Canyon soil is in the Shallow Limy range site and windbreak suitability group 10.

TfG—Tassel-Rock outcrop complex, 9 to 70 percent slopes. This map unit consists of the shallow, moderately steep to very steep, well drained Tassel soil and areas of Rock outcrop along upland drainageways. The Tassel soil formed in loamy material weathered from calcareous sandstone. The areas of Rock outcrop consist of calcareous sandstone that is exposed on the shoulders and ridgetops along the drainageways. Areas range from 20 to 300 acres in size. They consist of 40 to 60 percent Tassel soil and 20 to 30 percent areas of Rock outcrop. They are so intermingled or mixed that separating them in mapping is not practical.

Typically, the Tassel soil has a surface layer of grayish brown, very friable, calcareous very fine sandy loam about 6 inches thick. The transitional layer is light gray, very friable, calcareous very fine sandy loam about 3 inches thick. The underlying material is white, calcareous very fine sandy loam to a depth of 16 inches. Below this to a depth of more than 60 inches is white, calcareous sandstone. In some places the surface layer is loam or fine sandy loam. In some

areas the sandstone is below a depth of 20 inches. In other places the transitional layer and underlying material are fine sandy loam.

Typically, the areas of Rock outcrop consist of exposed white or light gray, calcareous sandstone. In most areas they do not support vegetation.

Included with this unit in mapping are small areas of Busher and Oglala soils. The included soils have a dark surface soil more than 7 inches thick and are more than 20 inches thick over sandstone. They are lower on the landscape than the Tassel soil and the areas of Rock outcrop. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Tassel soil, and available water capacity is very low. The organic matter content is moderately low. Runoff is rapid and very rapid.

All of the acreage in this map unit is used as range (fig. 14). It is not suited to farming because of the slope and the shallow depth to bedrock.

If this map unit is used as range, the climax vegetation on the Tassel soil is dominantly blue grama, sand bluestem, needleandthread, and little bluestem. These species make up 65 percent or more of the total annual forage. Prairie sandreed, switchgrass, and forbs make up the rest. If subject to continuous heavy grazing, little bluestem and switchgrass decrease in abundance and are replaced by sideoats grama, blue grama, hairy grama, prairie sandreed, sand dropseed, threadleaf sedge, and forbs. If overgrazing continues for many years, woody plants may invade the site.

If the range is in excellent condition, the suggested initial stocking rate on the Tassel soil is 0.5 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. The slope and the areas of Rock outcrop can hinder the movement of livestock. Brush management may be needed in some areas to control the woody plants that invade the site.

The Tassel soil generally is not suited to the trees and shrubs planted in windbreaks because of the slope and the shallow depth to bedrock. A few areas may be suitable for the trees or shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

The Tassel soil generally is not suitable for sanitary facilities because of the slope and the shallow depth to bedrock. A suitable alternative site should be selected. The soft sandstone can be excavated during the construction of dwellings with basements or buildings that have deep foundations. Dwellings and buildings also need to be properly designed so that they conform to the natural slope of the land. Cutting and filling are generally needed to provide a suitable grade for roads.

The land capability unit is VIIs-4, dryland, for the Tassel soil and VIIIs-8, dryland, for the areas of Rock outcrop. The Tassel soil is in the Shallow Limy range site. No range site is assigned to the areas of Rock outcrop. Both are in windbreak suitability group 10.

TgG—Tassel-Ponderosa-Rock outcrop association, 9 to 70 percent slopes. This map unit consists of the well drained, moderately steep to very steep Tassel and Ponderosa soils and areas of Rock outcrop. The shallow Tassel soil and the very deep Ponderosa soil formed in material weathered from calcareous sandstone. They are in the rough, tree-covered areas of the Pine Ridge. Deeply entrenched drainageways dissect the area. The Tassel soil and the areas of Rock outcrop are on ridgetops and the very steep upper side slopes. The Ponderosa soil is on the mid and lower side slopes. Areas range from 20 to several thousand acres in size. They consist of 20 to 40 percent Tassel soil, 25 to 35 percent Ponderosa soil, 10 to 20 percent areas of Rock outcrop, and 25 to 40 percent other soils, such as Vetal, Jayem, Oglala, Mitchell, Munjor, and Thirtynine soils. The two major soils and the areas of Rock outcrop are generally associated in a regular repeating pattern and are individually large enough to be mapped separately. The relative proportion of components can differ appreciably from one delineation to another.

Typically, the Tassel soil has a surface layer of pale brown, very friable, calcareous very fine sandy loam about 4 inches thick. The underlying material is very pale brown, calcareous very fine sandy loam to a depth of 14 inches. Very pale brown, calcareous sandstone is below a depth of about 14 inches. Many small sandstone fragments are scattered throughout the underlying material. In some places the surface layer, transitional layer, or underlying material is fine sandy loam or loamy very fine sand.

Typically, the Ponderosa soil has a surface layer of grayish brown, very friable very fine sandy loam about 9 inches thick. The transitional layer is pale brown, very friable very fine sandy loam about 14 inches thick. The underlying material is very pale brown, calcareous very fine sandy loam to a depth of 60 inches or more. Many small sandstone fragments are scattered throughout the underlying material. In some places the surface layer, transitional layer, or underlying material is loamy very fine sand.

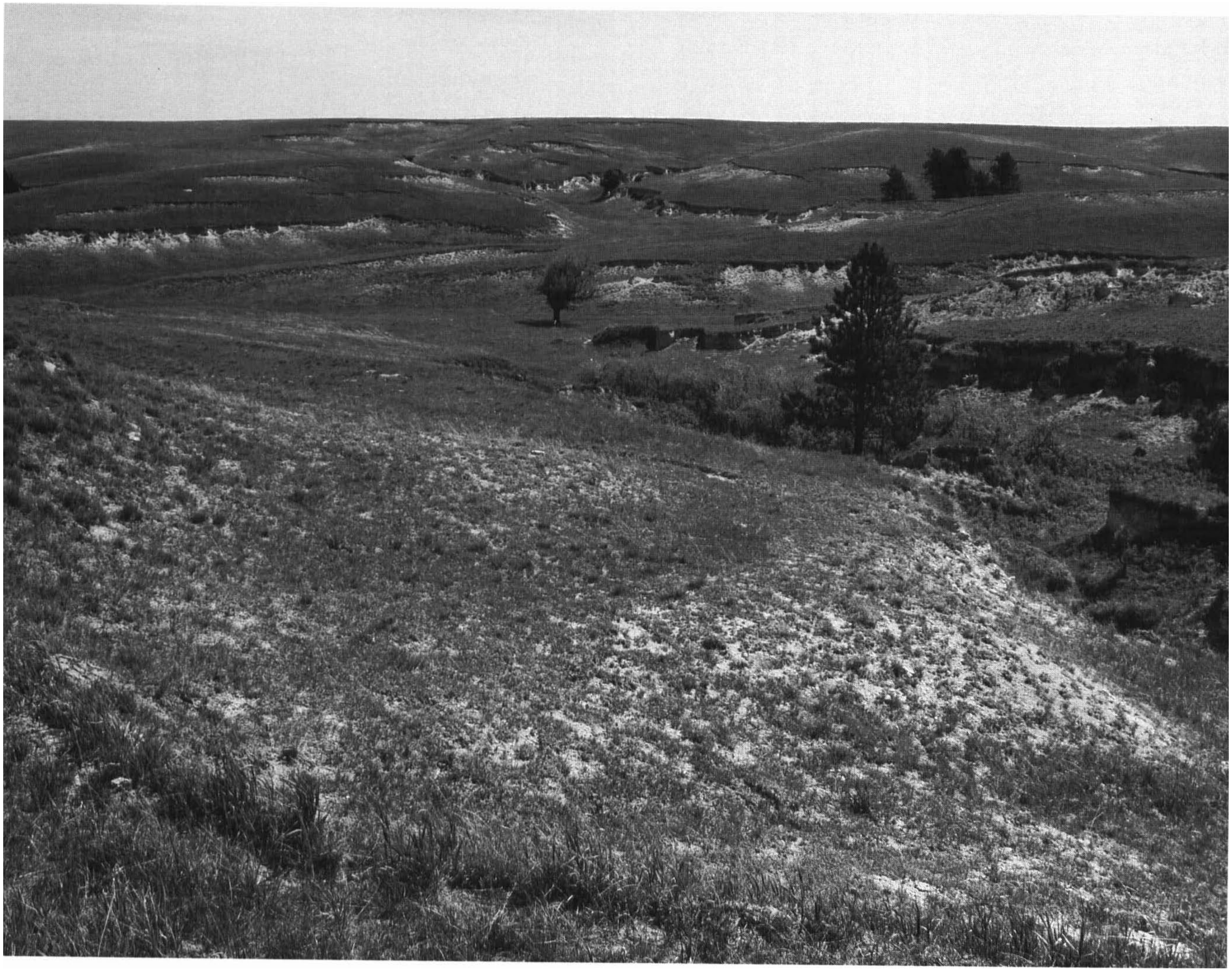


Figure 14.—A typical area of Tassel-Rock outcrop complex, 9 to 70 percent slopes, used as rangeland.

The areas of Rock outcrop consist of calcareous sandstone.

Included with this unit in mapping are small areas of Oglala, Munjor, and Vetal soils. Oglala soils have sandstone at a depth of 20 to 40 inches and are on similar landscapes as the Tassel and Ponderosa soils. Munjor soils are stratified, are on creek bottoms, and are subject to flooding. Vetal soils are very deep, have a dark surface soil more than 20 inches thick, and are on footslopes. Included soils make up 5 to 25 percent of the unit.

Permeability is moderately rapid in the Tassel and Ponderosa soils. Available water capacity is very low in the Tassel soil and high in the Ponderosa soil. The organic matter content is moderately low in the Tassel and Ponderosa soils. Runoff is rapid.

This association is used as rangeland, woodland, wildlife habitat, and recreational areas. It is not suited to cropland because of the slope.

About 50 to 75 percent of this association supports a mixture of grasses and trees, and the rest supports grazeable woodland or forest. If the Tassel and Ponderosa soils are used as range, the climax vegetation on the Tassel soil is dominantly blue grama, sand bluestem, needleandthread, and little bluestem. These species make up 45 percent or more of the total annual forage. Prairie sandreed, switchgrass, and forbs make up the rest. The climax vegetation on the Ponderosa soil is dominantly blue grama, sand bluestem, needleandthread, and little bluestem. These species make up 45 percent or more of the total annual forage. Prairie sandreed, switchgrass, green needlegrass, bluegrass, and forbs make up the rest. Ponderosa pine covers 5 to 15 percent of the area. If

subject to continuous heavy grazing, sand bluestem, little bluestem, and switchgrass decrease in abundance on the Ponderosa soil, and little bluestem and switchgrass decrease in abundance on the Tassel soil. They are replaced by needleandthread, prairie sandreed, blue grama, Scribner panicum, sand dropseed, and forbs on the Ponderosa soil and sideoats grama, blue grama, hairy grama, prairie sandreed, sand dropseed, threadleaf sedge, and forbs on the Tassel soil. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive. Woody plants may invade the site on the Tassel soil.

If the range is in excellent condition, the suggested initial stocking rate is 0.5 animal unit month per acre. The range should be closely monitored during use and the stocking rates adjusted so that one soil does not become overgrazed. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. The slope and the areas of Rock outcrop can hinder the movement of livestock. Brush management may be needed in some areas to control the undesirable woody plants that invade the site.

These soils are generally not suited to the trees and shrubs planted in windbreaks because of the slope and the shallow depth to bedrock in areas of the Tassel soil. Some areas are suitable for the trees or shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used. Onsite investigation is needed to identify the areas that are suitable for planting trees. The grazeable woodland or forest in this association consists of dense stands of ponderosa pine, dominantly on the steep and very steep, north- and east-facing slopes in areas where the soils are deepest. Along the streams and drainageways, stands of such deciduous trees as green ash, American elm, and eastern cottonwood are common. Onsite investigation is needed to identify the areas that are suitable for timber production.

This association is suited to wildlife habitat and recreational uses. In addition to its scenic beauty, it provides excellent habitat for many species of animals and birds, including deer and wild turkey.

The Tassel and Ponderosa soils generally are not suitable for sanitary facilities because of the slope, the shallow depth to bedrock in areas of the Tassel soil, and the areas of Rock outcrop. Dwellings need to be properly designed so that they conform to the natural slope of the land, or the soil can be graded to a suitable gradient. In areas of the Tassel soil, the soft bedrock can be excavated during the construction of dwellings with basements or buildings that have deep foundations. In areas of the Ponderosa soil, the sides of shallow excavations can cave in unless they are shored. Cutting and filling generally can provide a suitable grade for roads. In areas of the Ponderosa soil, a good surface drainage system can minimize the damage to roads caused by frost action. Onsite investigation is needed before any engineering practices are applied.

The land capability unit is VIIs-4, dryland, for the Tassel soil; VIe-3, dryland, for the Ponderosa soil; and VIIIs-8, dryland, for the areas of Rock outcrop. The Tassel soil is in the Shallow Limy range site, and the Ponderosa soil is in the Savannah range site. No range site is assigned to the areas of Rock outcrop. The Tassel and Ponderosa soils and the areas of Rock outcrop are in windbreak suitability group 10.

ThB—Thirtynine loam, 1 to 3 percent slopes. This very deep, very gently sloping, well drained soil is on uplands. It formed in loamy material weathered from siltstone. Areas range from 5 to 400 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 8 inches thick. The subsurface layer is dark grayish brown, friable loam about 7 inches thick. The subsoil is 15 inches thick. The upper part is brown, firm silty clay loam, and the lower part is very pale brown, friable, calcareous loam. The underlying material is very pale brown, calcareous loam to a depth of more than 60 inches. In some places the surface layer is silt loam or very fine sandy loam. In some areas siltstone is within a depth of 60 inches.

Included with this soil in mapping are small areas of Bridget and Mitchell soils. Bridget soils have less clay in the profile than the Thirtynine soil and are lower on the landscape. Mitchell soils do not have a dark surface layer and are on the steeper slopes. Included soils make up 10 to 15 percent of the unit.

Permeability is moderate in the Thirtynine soil, and available water capacity is high. The organic matter content is moderate. Runoff is slow. The water intake rate is moderately low.

Most of the acreage of this soil is used for dryland farming. A few areas are irrigated. The rest is used as rangeland.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Soil blowing and water erosion are slight hazards in areas where the soil surface is

not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, helps to conserve soil moisture and control soil blowing and water erosion. Returning crop residue to the soil helps to maintain the organic matter content and fertility and improves the water intake rate.

If irrigated, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. It is suited to sprinkler and gravity irrigation systems. Some land leveling is generally needed for gravity systems to ensure the uniform distribution of water. Soil blowing and water erosion are slight hazards. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control erosion and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone. Incorporating crop residue and green manure crops into the soil helps improve the organic matter content and fertility.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with other crops. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or trefoil, or warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Continuous heavy grazing causes poor plant vigor. Managing separate pastures of cool- and warm-season grasses can extend the grazing season. Rotation grazing and proper stocking help to maintain or improve the condition of the grasses. Soil tests can indicate a need for fertilization to improve the growth and vigor of the grasses. Irrigation water can be applied by sprinkler or gravity systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil erosion. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. As a result, water erosion and soil blowing are excessive. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and erosion are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Planting an annual cover crop between the tree rows helps to control soil blowing. Seedlings can survive and grow if competing vegetation between the rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the tree rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

The moderate permeability of this soil is a limitation affecting septic tank absorption fields, but increasing the size of the absorption field generally can overcome this limitation. Strengthening the foundations of buildings and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. Roads built on this soil should be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The land capability units are IIe-1, dryland, and IIe-4, irrigated; Silty range site; and windbreak suitability group 3.

ThC—Thirtynine loam, 3 to 6 percent slopes. This very deep, gently sloping, well drained soil is on uplands. It formed in loamy material weathered from siltstone. Areas range from 5 to 200 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 8 inches thick. The subsoil is about 19 inches thick. The upper part is grayish brown, firm silty clay loam, and the middle part is light gray, firm, calcareous silty clay loam. The lower part is white, friable, calcareous silt loam. The underlying material is white, calcareous very fine sandy loam to a depth of more than 60 inches. In some places the surface layer is silt loam or very fine sandy loam. In other places siltstone is within a depth of 60 inches. In cultivated areas 5 to 20 percent of this soil is eroded. In these areas erosion has removed all or most of the original surface soil, and tillage has mixed the remaining surface soil with the subsoil. In most places the surface layer is light in color and calcareous. In some places the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Bridget, Epping, and Mitchell soils. Mitchell soils do not have a dark surface layer and are on the steeper landscapes. Bridget soils have less clay in the profile than the Thirtynine soil and are lower on the landscape. Epping soils have siltstone within a depth of 20 inches and are on knolls and ridgetops. Included soils make up 10 to 15 percent of the unit.

Permeability is moderate in the Thirtynine soil, and available water capacity is high. The organic matter content is moderate. Runoff is medium. The water intake rate is moderately low.

Most of the acreage of this soil is used for dryland farming. A few areas are irrigated. The rest is used mainly as rangeland.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Water erosion and soil blowing are the principal hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, that keeps crop residue on the surface helps to control water erosion and soil blowing and conserve soil moisture. The use of cover crops during the winter helps to control soil blowing. Terraces and contour farming are also effective in controlling erosion and conserving moisture. Returning crop residue to the soil helps to maintain the organic matter content and fertility and improves the water intake rate.

If irrigated by a sprinkler system, this soil is suited to corn, field beans, small grains, alfalfa, and introduced grasses. Extensive land leveling is generally needed for gravity irrigation systems. Soil erosion is the principal hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil erosion and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue and green manure crops into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone and result in water erosion on these slopes.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with other crops. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or trefoil, or warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. This soil is subject to water erosion. Continuous heavy grazing causes poor plant vigor and can result in the formation of small gullies and rills after heavy rains. Managing separate pastures of cool- and warm-season grasses can extend the grazing season. Rotation grazing and proper stocking help to maintain or improve the condition of the grasses. Nitrogen or phosphate fertilizer, or both, improves the growth and vigor of the grasses. Irrigation water can be applied by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil erosion. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. As a result, water erosion and soil blowing are excessive. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants. Range seeding may be needed to stabilize severely eroded areas of cropland.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and erosion are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Planting the trees on the contour and terracing help to control water erosion. Planting an annual cover crop between the tree rows helps to control soil blowing. Seedlings can survive and grow if competing vegetation between the rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the tree rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

The moderate permeability of this soil is a limitation affecting septic tank absorption fields, but increasing the size of the absorption field generally can overcome this limitation. Strengthening the foundations of buildings and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. Buildings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. Roads need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil material. Coarser grained base material can be used to ensure better performance.

The land capability units are IIIe-1, dryland, and IIIe-4, irrigated; Silty range site; and windbreak suitability group 3.

ThD—Thirtynine loam, 6 to 9 percent slopes. This very deep, strongly sloping, well drained soil is on uplands. It formed in loamy material weathered from siltstone. Areas range from 5 to more than 500 acres in size.

Typically, the surface layer is grayish brown, friable loam about 8 inches thick. The subsoil is 17 inches thick. The upper part is brown and light brownish gray, firm silty clay loam. The lower part is light gray, friable, calcareous silt loam about 4 inches thick. The underlying material is very pale brown, calcareous very fine sandy loam to a depth of more than 60 inches. In some places the surface layer is silt loam or very fine sandy loam. In other places siltstone is within a depth of 60 inches. In cultivated areas 15 to 30 percent of this soil is eroded. In these areas erosion

has removed all or most of the original surface soil, and tillage has mixed the remaining surface soil with the subsoil. In most places the surface layer is light in color and calcareous. In some places the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Bridget, Epping, and Mitchell soils. Bridget soils have less clay in the profile than the Thirtynine soil and are lower on the landscape. Epping soils have siltstone at a depth of 10 to 20 inches and are on ridges and shoulders of side slopes. Mitchell soils do not have a dark surface layer. Included soils make up 10 to 15 percent of the unit.

Permeability is moderate in the Thirtynine soil, and available water capacity is high. The organic matter content is moderate. Runoff is medium. The water intake rate is moderately low.

Most of the acreage of this soil supports native grasses and is used as range. Some areas are used for cultivated crops.

If dryland farmed, this soil is poorly suited to small grains, alfalfa, and introduced grasses. Inadequate rainfall in summer generally limits the crops that can be grown. Water erosion and soil blowing are hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and stripcropping, that keeps crop residue on the surface helps to control soil blowing and water erosion and conserve soil moisture. Incorporating crop residue into the soil helps improve the organic matter content and fertility.

If irrigated by a sprinkler system, this soil is poorly suited to corn, small grains, alfalfa, and introduced grasses. It is not suited to gravity irrigation because of the slope. Water erosion and soil blowing are severe hazards in areas where the surface is not protected by crops or crop residue. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control water erosion and soil blowing and conserve soil moisture. The use of cover crops during the winter helps to control soil blowing. Returning crop residue and green manure crops to the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone and result in water erosion on these slopes.

This soil is poorly suited to introduced grasses used as pasture and hayland. These grasses can be rotated with other crops. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or trefoil, or warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. This soil is subject to water erosion. Continuous heavy grazing causes poor plant vigor and can result in the formation of small gullies and rills after heavy rains. Managing separate pastures of cool- and warm-season grasses can extend the grazing season. Rotation grazing and proper stocking help to maintain or improve the condition of the grasses. Nitrogen or phosphate fertilizer, or both, improves the growth and vigor of the grasses. Irrigation water can be applied by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

If this soil is used for range or native hay, the climax vegetation is dominantly blue grama, little bluestem, sideoats grama, and western wheatgrass. These species make up 50 percent or more of the total annual forage. Buffalograss, needleandthread, prairie junegrass, Scribner panicum, big bluestem, switchgrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, big bluestem, little bluestem, prairie junegrass, and switchgrass decrease in abundance and are replaced by blue grama, buffalograss, needleandthread, plains muhly, sand dropseed, tall dropseed, western wheatgrass, and forbs. If overgrazing continues for many years, the native grasses lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range. In areas where gullies have formed because of severe water erosion, land shaping or other mechanical practices may be needed to smooth and stabilize the site before it is reseeded.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and soil erosion are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Planting the trees on the contour and terracing help to control water erosion. Planting an annual cover crop between the tree rows helps to control soil blowing. Seedlings can survive and grow if competing vegetation between the rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the tree rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

The moderate permeability of this soil is a limitation affecting septic tank absorption fields, but increasing the size of the absorption field generally can overcome this limitation. Strengthening the foundations of buildings and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. Buildings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. Roads built on this soil need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil. Coarser grained base material can be used to ensure better performance.

The land capability units are IVe-1, dryland, and IVe-4, irrigated; Silty range site; and windbreak suitability group 3.

To—Tryon fine sandy loam, 0 to 1 percent slopes. This very deep, nearly level, poorly drained soil is in sandhill valleys. It formed in eolian sand and sandy alluvium. This soil is subject to rare flooding. Areas range from 20 to 500 acres in size.

Typically, the surface layer is very dark grayish brown, very friable fine sandy loam about 6 inches thick. The underlying material extends to a depth of more than 60 inches. The upper part is light brownish gray fine sand; the middle part is light brownish gray, mottled loamy fine sand; and the lower part is light gray fine sand. In some places the profile is calcareous. In a few areas the soil is very poorly drained. In some areas the surface layer is loam or loamy fine sand.

Included with this soil in mapping are small areas of Els, calcareous; Gannett; Ipage; and Marlake soils. Els, calcareous, and Ipage soils are better drained than the Tryon soil and are higher on the landscape. Gannett soils have more silt and clay in the profile than the Tryon soil and are on similar landscapes. Marlake soils are lower on the landscape than the Tryon soil and have water above the surface for much of the growing season. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Tryon soil, and available water capacity is low. The organic matter content is high. Runoff is very slow. The soil has a seasonal high water table that ranges from the surface during wet years to a depth of about 1.5 feet during dry years. The water table normally recedes to a depth of 2 to 3 feet in late summer.

Most of the acreage of this soil supports native grasses used as hayland. A few areas are used for range.

This soil is not suited to farming because of the wetness caused by the high water table.

If this soil is used as range or hayland, the climax vegetation is dominantly big bluestem, indiangrass, prairie cordgrass, and switchgrass. These species make up 60 percent or more of the total annual forage. Bluegrass, slender wheatgrass, sedges, rushes, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, big bluestem, prairie cordgrass, switchgrass, and indiangrass decrease in abundance and are replaced by slender wheatgrass, western wheatgrass, plains muhly, and sedges. If overgrazing or improper haying continues for many years, bluegrass, western wheatgrass, sedges, rushes, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 1.8 animal unit months per acre. A planned grazing system that includes proper grazing use, timely deferments from grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities result in a more uniform distribution of grazing. During wet periods, grazing and operating heavy machinery cause surface compaction and the formation of small mounds and ruts, which make grazing or harvesting hay difficult.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. Large meadows can be divided into three sections and the sections mowed in rotation. The order in which the sections are mowed should be changed in successive years. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in the spring before the ground thaws and the water table reaches a high level.

This soil is suited to the trees and shrubs planted in windbreaks. The main limitation affecting the establishment of windbreaks is the wetness caused by the high water table. The species selected for planting should be those that can withstand the occasional wetness. Tilling and planting seedlings should be delayed until after the soil has begun to dry. The weeds and undesirable grasses can be controlled by cultivating between the tree rows with conventional equipment and by the use of the appropriate kind of herbicide in the rows.

This soil is not suited to septic tank absorption fields or building sites because of the wetness caused by the high water table and the flooding. A suitable alternative site should be selected. The sides of shallow excavations can cave in unless they are shored. The excavations should be made during dry

periods. Constructing roads on suitable, well compacted fill material above the flood level, providing adequate side ditches, and installing culverts help protect roads from the damage caused by the flooding and the wetness.

The land capability unit is Vw-7, dryland; Wet Subirrigated range site; and windbreak suitability group 2D.

Tp—Tryon fine sandy loam, wet, 0 to 1 percent slopes. This very deep, nearly level, very poorly drained soil is in sandhill valleys. It formed in eolian sand and sandy alluvium. This soil is subject to rare flooding and is occasionally ponded in the spring and during wet periods. Areas range from 20 to 50 acres in size.

Typically, a layer of plant litter about 2 inches thick is on the surface. The surface layer is dark gray, friable fine sandy loam about 5 inches thick. The underlying material is light gray and white, mottled fine sand to a depth of more than 60 inches. In some places the profile is calcareous. In some areas the dark surface soil is more than 9 inches thick. In other places the surface layer is loam or loamy fine sand.

Included with this soil in mapping are small areas of Els, calcareous; Gannett; and Marlake soils. Els, calcareous, soils are somewhat poorly drained and are higher on the landscape than the Tryon soil. Gannett soils have more silt and clay in the profile than the Tryon soil and are on similar landscapes. Marlake soils are lower on the landscape than the Tryon soil and have water above the surface for much of the growing season. Included soils make up 5 to 10 percent of the unit.

Permeability is rapid in the Tryon soil, and available water capacity is low. The organic matter content is high. Runoff is very slow or ponded. The seasonal high water table ranges from about 0.5 foot above the surface during wet years to a depth of about 1.0 foot during dry years. The water table normally recedes to a depth of 1 to 2 feet in late summer.

Nearly all of the acreage of this soil supports native grasses used for grazing or as hayland.

This soil is not suited to farming because of the wetness caused by the high water table.

If this soil is used as range or hayland, the climax vegetation is dominantly prairie cordgrass, bluejoint reedgrass, northern reedgrass, and rushes. These species make up 65 percent or more of the total annual forage. Bluegrass, slender wheatgrass, green muhly, sedges, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, prairie cordgrass, bluejoint reedgrass, and northern reedgrass decrease in abundance and are replaced by slender wheatgrass, bluegrass, green muhly, sedges, rushes, and forbs. If overgrazing or improper haying continues for many years, bluegrass, foxtail barley, sedges, rushes, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 2.0 animal unit months per acre. This soil produces a high quantity of low-quality forage. A planned grazing system that includes proper grazing use, timely deferments from grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. During wet periods, grazing and operating heavy machinery can cause surface compaction and the formation of mounds and ruts, which make grazing or harvesting hay difficult.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous. In wet years, some areas of hay cannot be harvested. After the ground is frozen, livestock can graze without damaging the meadows. They should be removed in the spring before the ground thaws.

This soil is not suited to the trees and shrubs planted in windbreaks because of the wetness caused by the high water table. A few marginal areas may be suitable for the trees or shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

This soil is not suited to septic tank absorption fields or building sites because of the wetness caused by the high water table and the flooding. A suitable alternative site should be selected. The sides of shallow excavations can cave in unless they are shored. The excavations should be made during dry periods. Constructing roads on suitable, well compacted fill material above the level of ponding or flooding, providing adequate side ditches, and installing culverts help protect roads from the damage caused by ponding and the wetness.

The land capability unit is Vw-7, dryland; Wetland range site; and windbreak suitability group 10.

TtB—Tuthill loamy fine sand, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, well drained soil is on uplands. It formed in loamy and sandy material. Areas range from 5 to 200 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 7 inches thick. The subsurface layer is dark grayish brown, very friable loamy fine sand about 4 inches thick. The subsoil is about 19 inches thick. It is grayish brown and brown, firm sandy clay loam in the upper part and brown, very

friable fine sandy loam in the lower part. The underlying material is pale brown fine sand to a depth of 60 inches or more. In some areas the dark surface soil is less than 7 inches thick. In a few places the surface layer is fine sandy loam. In some areas the sandy underlying material is below a depth of 40 inches. In some places the underlying material is calcareous.

Included with this soil in mapping are small areas of Dailey, Jayem, Valent, and Vetal soils. The included soils have more sand in the profile than the Tuthill soil. Dailey and Valent soils are higher on the landscape. Jayem soils are on similar landscapes as the Tuthill soil. Vetal soils have a dark surface soil more than 20 inches thick and are lower on the landscape than the Tuthill soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the subsoil in the Tuthill soil and rapid in the underlying material. Available water capacity is moderate. The organic matter content is moderately low. Runoff is slow. The water intake rate is high.

Most of the acreage of this soil is used for range. The rest is used as cropland.

If dryland farmed, this soil is poorly suited to small grains, alfalfa, and introduced grasses. Inadequate rainfall in summer generally limits the cultivated crops that can be grown. Soil blowing is the principal hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. Stripcropping and the use of cover crops during the winter help to control soil blowing.

If irrigated by a sprinkler system, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. This soil is not suited to gravity irrigation systems because of the high water intake rate. Soil blowing is the principal hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone.

If this soil is used for range or native hay, the climax vegetation is dominantly prairie sandreed, sand bluestem, needleandthread, and little bluestem. These species make up 60 percent or more of the total annual forage. Blue grama, switchgrass, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, prairie sandreed, blue grama, Scribner panicum, sand dropseed, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain healthy and vigorous.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and soil blowing are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Cultivation between the rows with conventional equipment can control the undesirable grasses and weeds in areas where strips of sod and cover crops are not used. The weeds and undesirable grasses in the tree rows can be controlled by the careful use of the appropriate kind of herbicide or hoeing by hand.

This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. Strengthening the foundations for dwellings and buildings without basements and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. The walls or sides of shallow excavations can be shored to prevent sloughing or caving. Mixing the base material with additives, such as hydrated lime, helps to prevent excessive shrinking and swelling.

The land capability units are IVe-6, dryland, and IIIe-10, irrigated; Sandy range site; and windbreak suitability group 5.

TtD—Tuthill loamy fine sand, 3 to 9 percent slopes. This very deep, gently sloping and strongly sloping, well drained soil is on uplands. It formed in

loamy and sandy material. Areas range from 5 to 50 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 7 inches thick. The subsurface layer is also dark grayish brown, very friable loamy fine sand about 3 inches thick. The subsoil is 18 inches thick. The upper part is grayish brown and light brownish gray, firm sandy clay loam. The lower part is pale brown, friable fine sandy loam. The underlying material is fine sand to a depth of 60 inches or more. The upper part is light gray, and the lower part is white and calcareous. In some places the surface soil is fine sandy loam. In some areas the dark surface soil is less than 7 inches thick. In cultivated areas 20 to 35 percent of this soil is eroded. In these areas erosion has removed all or most of the original surface soil, and tillage has mixed the remaining surface soil with the subsoil. In most places the surface layer is light in color. In other places the surface layer is sandy clay loam or clay loam. In some areas the sandy underlying material is below a depth of 40 inches.

Included with this soil in mapping are small areas of Dailey, Jayem, Valent, and Vetal soils. Dailey, Valent, and Vetal soils have more sand in the profile than the Tuthill soil. Dailey and Valent soils are higher on the landscape. Vetal soils have a dark surface soil more than 20 inches thick and are lower on the landscape than the Tuthill soil. Jayem soils have less clay in the subsoil than the Tuthill soil and are on similar landscapes. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the subsoil in the Tuthill soil and rapid in the underlying material. Available water capacity is moderate. The organic matter content is moderately low. Runoff is medium. The water intake rate is high.

Most of the acreage of this soil is used for range. The rest is used as irrigated cropland.

This soil is not suited to dry-farmed crops because of droughtiness and the hazard of soil blowing.

If irrigated by a sprinkler system, this soil is poorly suited to corn, small grains, alfalfa, and introduced grasses. It is not suited to gravity irrigation systems because of the slope and the high water intake rate. Water erosion and soil blowing are severe hazards in areas where the surface is not protected by crops or crop residue. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control water erosion and soil blowing and conserve soil moisture. The use of winter cover crops helps to control soil blowing. Returning crop residue and green manure crops to the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone and result in water erosion on these slopes.

If this soil is used for range or native hay, the climax vegetation is dominantly prairie sandreed, sand bluestem, needleandthread, and little bluestem. These species make up 60 percent or more of the total annual forage. Blue grama, switchgrass, and other forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, prairie sandreed, blue grama, Scribner panicum, sand dropseed, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and erosion are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Soil blowing can be controlled by maintaining strips of sod or cover crops between the tree rows. Planting the trees on the contour and terracing help to control water erosion. Seedlings can survive and grow if competing vegetation between the tree rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. Strengthening the foundations for dwellings and buildings without basements and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. Buildings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. Mixing the base material

with additives, such as hydrated lime, helps to prevent excessive shrinking and swelling.

The land capability units are VIe-6, dryland, and IVe-10, irrigated; Sandy range site; and windbreak suitability group 5.

TwB—Tuthill fine sandy loam, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, well drained soil is on uplands. It formed in loamy and sandy material. Areas range from 5 to 600 acres in size.

Typically, the surface layer is dark grayish brown, very friable fine sandy loam about 11 inches thick. The subsoil is firm sandy clay loam about 17 inches thick. The upper part is grayish brown, and the lower part is light grayish brown. The underlying material is white fine sand to a depth of more than 60 inches. In some places the sandy material is below a depth of 40 inches. In some areas the dark surface layer is less than 7 inches thick and is loamy fine sand. In other places the underlying material is calcareous.

Included with this soil in mapping are small areas of Jayem, Keya, and Vetal soils. Jayem soils have less clay in the subsoil than the Tuthill soil and are on similar landscapes. Keya and Vetal soils have a dark surface soil more than 20 inches thick and are lower on the landscape than the Tuthill soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the subsoil in the Tuthill soil and rapid in the underlying material. Available water capacity is moderate. The organic matter content is moderately low. Runoff is slow. The water intake rate is moderate.

Most of the acreage of this soil is used for farming. A few areas are used for range.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Soil blowing is the main hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, that keeps crop residue on the surface helps to control erosion and conserve soil moisture. The use of cover crops during the winter helps to control soil blowing. Returning crop residue to the soil helps to maintain the organic matter content and fertility and improves the water intake rate.

If irrigated, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. It is best suited to sprinkler and gravity irrigation systems. Some land leveling is generally needed for gravity systems to ensure the uniform distribution of water. Soil blowing is the principal hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control erosion and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue and green manure crops into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with other crops. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or trefoil, or warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Continuous heavy grazing reduces the amount of protective cover and the quality of the stands and can result in a severe hazard of soil blowing. Managing separate pastures of cool- and warm-season grasses can extend the grazing season. Rotation grazing and proper stocking help to maintain or improve the condition of the grasses. Nitrogen or phosphate fertilizer, or both, improves the growth and vigor of the grasses. Irrigation water can be applied by sprinkler or gravity systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants very effectively controls soil blowing. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. As a result, soil blowing is excessive. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and soil blowing are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Seedlings can survive and grow if competing vegetation between the rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the tree rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. Strengthening the foundations for dwellings and buildings without basements and backfilling with coarse textured material help to

prevent the damage caused by shrinking and swelling. The walls and sides of shallow excavations can be temporarily shored to prevent sloughing or caving. Mixing the base material for roads and streets with additives, such as hydrated lime, helps to prevent shrinking and swelling.

The land capability units are IIIe-3, dryland, and IIe-5, irrigated; Sandy range site; and windbreak suitability group 5.

TwC—Tuthill fine sandy loam, 3 to 6 percent slopes. This very deep, gently sloping, well drained soil is on uplands. It formed in loamy and sandy material. Areas range from 5 to 700 acres in size.

Typically, the surface layer is dark grayish brown, very friable fine sandy loam about 9 inches thick. The subsoil is firm sandy clay loam about 12 inches thick. The upper part is dark brown, and the lower part is brown. The underlying material extends to a depth of more than 60 inches. It is pale brown loamy fine sand in the upper part and very pale brown fine sand in the lower part. In some places the surface layer is loam or loamy fine sand. In some areas the dark surface soil is less than 7 inches thick. In cultivated areas 15 to 30 percent of this soil is eroded. In these areas erosion has removed all or most of the original surface soil, and tillage has mixed the remaining surface soil with the subsoil. In most places the surface layer is light in color. In other places the surface layer is sandy clay loam or clay loam. In other areas the sandy underlying material is below a depth of 40 inches.

Included with this soil in mapping are small areas of Dailey, Jayem, Keya, Satanta, and Vetal soils. Dailey soils have more sand in the upper part of the profile than the Tuthill soil and are higher on the landscape. Jayem soils have less clay in the subsoil than the Tuthill soil and are on similar landscapes. Satanta soils do not have sandy material within a depth of 40 inches and are on similar landscapes as the Tuthill soil. Vetal and Keya soils have a dark surface soil more than 20 inches thick and are lower on the landscape than the Tuthill soil. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the subsoil in the Tuthill soil and rapid in the underlying material. Available water capacity is moderate. The organic matter content is moderately low. Runoff is medium. The water intake rate is moderate.

Most of the acreage of this soil is used for range. Some areas are used for farming.

If dryland farmed, this soil is suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be successfully grown. Water erosion and soil blowing are the principal hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, that keeps crop residue on the surface helps to control soil blowing and water erosion and conserve soil moisture. Cover crops also help to control erosion. Terraces and contour farming are also effective in controlling erosion and conserving moisture. Returning crop residue to the soil helps to maintain the organic matter content and fertility and improves the water intake rate.

If irrigated by a sprinkler system, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. Extensive land leveling is generally needed for gravity irrigation systems to be used on this soil. Soil blowing and water erosion are the principal hazards. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control erosion and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue and green manure crops into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients and pesticides below the root zone and result in water erosion on these slopes.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with other crops. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or trefoil, or warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. This soil is subject to water erosion. Continuous heavy grazing causes poor plant vigor and can result in the formation of small gullies and rills after heavy rains. Continuous heavy grazing also reduces the amount of protective cover and the quality of the stands, resulting in a severe hazard of soil blowing. Managing separate pastures of cool- and warm-season grasses can extend the grazing season. Rotation grazing and proper stocking help to maintain or improve the condition of the grasses. Nitrogen or phosphate fertilizer, or both, improves the growth and vigor of the grasses. Irrigation water can be applied by sprinkler systems. Weeds can be controlled if the appropriate kind of herbicide is applied.

If this soil is used for range or native hay, the climax vegetation is dominantly prairie sandreed, big bluestem, needleandthread, and little bluestem. These species make up 75 percent or more of the total annual forage. Blue grama, sand bluestem, switchgrass, and forbs make up the rest. If subject to

continuous heavy grazing, sand bluestem, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, prairie sandreed, blue grama, Scribner panicum, sand dropseed, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and erosion are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Cultivation between the rows with conventional equipment can control the undesirable grasses and weeds in areas where strips of sod and cover crops are not used. The weeds and undesirable grasses in the tree rows can be controlled by the careful use of the appropriate kind of herbicide or hoeing by hand.

This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. Strengthening the foundations for dwellings and buildings without basements and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. Buildings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. The walls and sides of shallow excavations can be temporarily shored to prevent sloughing or caving. Mixing the base material for roads and streets with additives, such as hydrated lime, helps to prevent shrinking and swelling.

The land capability units are IIIe-3, dryland, and IIIe-5, irrigated; Sandy range site; and windbreak suitability group 5.

TwD—Tuthill fine sandy loam, 6 to 11 percent slopes. This very deep, strongly sloping, well drained soil is on uplands. It formed in loamy and sandy material. Areas range from 5 to 200 acres in size.

Typically, the surface layer is grayish brown, very friable fine sandy loam about 8 inches thick. The subsoil is 14 inches thick. The upper part is grayish brown, firm sandy clay loam. The lower part is light brownish gray, friable sandy clay loam. The underlying material to a depth of more than 60 inches is white. The upper part is loamy fine sand, and the lower part is calcareous fine sand. In some areas the dark surface layer is less than 7 inches thick and is loam or loamy fine sand. In cultivated areas 20 to 35 percent of this soil is eroded. In these areas erosion has removed all or most of the original surface soil, and tillage has mixed the remaining surface soil with the subsoil. In most places the surface layer is light in color. In other places the surface layer is sandy clay loam or loam. In a few areas the sandy underlying material is below a depth of 40 inches. In some places the underlying material is calcareous.

Included with this soil in mapping are small areas of Dailey, Jayem, and Valent soils. Dailey and Valent soils have more sand than the Tuthill soil and are higher on the landscape. Jayem soils have less clay in the subsoil than the Tuthill soil and are on similar landscapes. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the subsoil in the Tuthill soil and rapid in the underlying material. Available water capacity is moderate. The organic matter content is moderately low. Runoff is medium. The water intake rate is moderate.

Most of the acreage of this soil is used for range. A few areas are used as irrigated cropland or are dryland farmed.

If dryland farmed, this soil is poorly suited to small grains, introduced grasses, and alfalfa. Inadequate rainfall in summer generally limits the cultivated crops that can be grown. Water erosion and soil blowing are the principal hazards in areas where the surface is not adequately protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, that keeps crop residue on the surface helps to control soil blowing and water erosion and conserve soil moisture. Stripcropping and annual cover crops help to control soil blowing. Terraces reduce the runoff rate and help to control water erosion.

If irrigated by a sprinkler system, this soil is poorly suited to corn, small grains, alfalfa, and introduced grasses. Soil blowing and water erosion are the principal hazards if the surface is unprotected. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control water erosion and soil blowing and conserve soil moisture. Returning crop residue and green manure crops to the soil helps improve the organic

matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients and pesticides below the root zone and result in water erosion on these slopes.

If this soil is used for range or native hay, the climax vegetation is dominantly prairie sandreed, big bluestem, needleandthread, and little bluestem. These species make up 75 percent or more of the total annual forage. Blue grama, sand bluestem, switchgrass, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, prairie sandreed, blue grama, Scribner panicum, sand dropseed, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and erosion are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Cultivation between the rows with conventional equipment can control the undesirable grasses and weeds in areas where strips of sod and cover crops are not used. The undesirable grasses and weeds in the tree rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in the pollution of ground water. Strengthening the foundations for dwellings and buildings without basements and backfilling with coarse textured material help to prevent the damage caused by shrinking and swelling. Dwellings and buildings also should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. The walls and sides of shallow excavations can be temporarily shored to prevent sloughing or caving. Mixing the base material for roads and streets with additives, such as hydrated lime, helps to prevent shrinking and swelling.

The land capability units are IVe-3, dryland, and IVe-5, irrigated; Sandy range site; and windbreak suitability group 5.

VaB—Valent fine sand, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, excessively drained soil is in sandhill valleys. It formed in eolian sand. Areas range from 5 to 300 acres in size.

Typically, the surface layer is grayish brown, very friable fine sand about 6 inches thick. The underlying material is pale brown and very pale brown fine sand to a depth of more than 60 inches. In some places the surface layer is loamy fine sand.

Included with this soil in mapping are small areas of Dailey and Ipage soils. Dailey soils have a dark surface soil more than 10 inches thick and are lower on the landscape than the Valent soil. Ipage soils are moderately well drained and are lower on the landscape than the Valent soil. In a few areas they are gently sloping. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Valent soil. Available water capacity and organic matter content are low. Runoff is slow. The water intake rate is very high.

Most of the acreage of this soil is used as rangeland. The rest is used as irrigated cropland.

This soil is not suited to dryland farming because of droughtiness and the hazard of soil blowing.

If irrigated by a sprinkler system, this soil is poorly suited to corn, small grains, alfalfa, and introduced grasses. It is too sandy for gravity irrigation systems. Frequent, light applications of water are needed. Soil blowing is the principal hazard. A system of conservation tillage, such as stubble mulching and ecofallow, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. Incorporating crop residue into the soil improves the organic matter content and fertility. Supplemental applications of nitrogen, phosphorus, zinc, and sulfur are needed for maximum crop production. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone.

If this soil is used for range or native hay, the climax vegetation is dominantly prairie sandreed, sand bluestem, needleandthread, and little bluestem. These species make up 65 percent or more of the total annual forage. Blue grama, switchgrass, and forbs make up the rest. If the pasture is overgrazed, sand bluestem, little bluestem, and switchgrass decrease in

abundance and are replaced by needleandthread, prairie sandreed, blue grama, Scribner panicum, sand dropseed, and forbs. If overgrazing continues for many years, the native plants lose vigor and soil blowing is excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. This soil is generally the first to be overgrazed in a pasture that includes the Sands or Choppy Sands range sites. Properly locating fences and livestock watering and salting facilities results in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, the forage should be harvested once every two years. During the year the forage is not harvested, the hayland should be used only as fall or winter range.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and soil blowing are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Because the soil is loose, trees should be planted in shallow furrows with as little disturbance of the soil as possible. Strips of sod or other vegetation is needed between the tree rows to control soil blowing. Seedlings can be damaged by high winds and covered by drifting sand. The undesirable grasses and weeds in the tree rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. This soil is generally suited to dwellings, buildings, and roads. Seeding the roadside after construction helps to stabilize the loose soil. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

The land capability units are VIe-5, dryland, and IVe-12, irrigated; Sandy range site; and windbreak suitability group 7.

VaD—Valent fine sand, 3 to 9 percent slopes. This very deep, gently sloping and strongly sloping, excessively drained soil is on dunes in the sandhills and in transitional areas bordering the sandhills. It formed in eolian sand. Areas range from 10 to 500 acres in size.

Typically, the surface layer is dark grayish brown, loose fine sand about 5 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches. In a few areas the surface layer is loamy fine sand.

Included with this soil in mapping are small areas of Dailey; Els, calcareous; Ipage; and Jayem soils. Dailey soils have a dark surface soil more than 10 inches thick and are lower on the landscape than the Valent soil. Els, calcareous, and Ipage soils are lower on the landscape than the Valent soil and are not as well drained. Jayem soils are well drained and have more silt in the profile than the Valent soil. These soils are on similar landscapes. In a few small areas the Valent soil is very gently sloping. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Valent soil, and available water capacity is low. The organic matter content is low. Runoff is slow. The water intake rate is very high.

Most of the acreage of this soil is used as rangeland. Some areas are used for irrigated crops.

This soil is not suited to dryland farming because it is too droughty and soil blowing is a severe hazard.

If irrigated by a sprinkler system, this soil is poorly suited to corn, small grains, alfalfa, and introduced grasses. It is too sandy for gravity irrigation systems. Frequent, light applications of water are needed. Soil blowing is the principal hazard. A system of conservation tillage, such as stubble mulching and ecofallow, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. Incorporating crop residue into the soil improves the organic matter content and fertility. Supplemental applications of nitrogen, phosphorus, zinc, and sulfur are needed for maximum crop production. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone.

If this soil is used as range or hayland, the climax vegetation is dominantly sand bluestem, little bluestem, prairie sandreed, and needleandthread. These species make up 65 percent or more of the total annual forage. Blue grama, switchgrass, sand lovegrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, sand lovegrass, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, blue grama, sand dropseed, sedges, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, soil blowing is excessive and blowouts can form.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying

helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and soil blowing are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Because the soil is loose, trees should be planted in shallow furrows with as little disturbance of the soil as possible. Strips of sod or other vegetation is needed between the tree rows to control soil blowing. Seedlings can be damaged by high winds and covered by drifting sand. The undesirable grasses and weeds in the tree rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. This soil is generally suited to dwellings and roads. Buildings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. Seeding the roadside after construction helps to stabilize the loose soil. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

The land capability units are VIe-5, dryland, and IVe-12, irrigated; Sands range site; and windbreak suitability group 7.

VaE—Valent fine sand, rolling. This very deep, excessively drained soil is on dunes in areas of the sandhills. It formed in eolian sand. Slopes range from 9 to 24 percent. Areas range from 80 to 2,000 acres in size.

Typically, the surface layer is grayish brown, loose fine sand about 4 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches.

Included with this soil in mapping are small areas of Dailey; Els, calcareous; and Ipage soils. Dailey soils have a dark surface soil more than 10 inches thick. Els, calcareous, soils are somewhat poorly drained, and Ipage soils are moderately well drained. These soils are lower on the landscape than the Valent soil. In a few places the soil is very steep. Included soils make up 5 to 10 percent of the unit.

Permeability is rapid in the Valent soil, and available water capacity is low. The organic matter content is low. Runoff is slow and medium.

Nearly all of the areas of this soil support native grasses used for grazing or as hayland.

This soil is not suited to farming because of the slope, droughtiness, and the severe hazard of soil blowing.

If this soil is used as range or hayland, the climax vegetation is dominantly sand bluestem, little bluestem, prairie sandreed, and needleandthread. These species make up 65 percent or more of the total annual forage. Blue grama, switchgrass, sand lovegrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, sand lovegrass, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, blue grama, sand dropseed, sedges, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, soil blowing is excessive and blowouts can form.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and soil blowing are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Because the soil is loose, trees should be planted in shallow furrows with as little disturbance of the soil as possible. Strips of sod or other vegetation is needed between the tree rows to control soil blowing. Seedlings can be damaged by high winds and covered by drifting sand. The undesirable grasses and weeds in the tree rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. Land shaping and installing septic tank absorption fields on the contour are generally necessary for their proper operation. Dwellings and buildings need to be properly designed so that they conform to the natural slope of the land, or the soil can be graded to a suitable gradient. Cutting and filling are generally needed to provide a suitable grade for roads. Seeding the roadside after construction helps to

stabilize the loose soil. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

The land capability unit is VIe-5, dryland; Sands range site; and windbreak suitability group 7.

VaF—Valent complex, rolling and hilly. This very deep, excessively drained soil is on dunes in the sandhills. It formed in eolian sand. Individual areas range from 80 to several thousand acres in size. They consist of 55 to 80 percent Valent fine sand, rolling, and 20 to 45 percent Valent fine sand, hilly. Slopes range from 9 to 24 percent in the rolling part and 24 to 60 percent in the hilly part. Catsteps are common on the side slopes in the hilly part. These soils are so intermingled or mixed that separating them in mapping is not practical.

Typically, the surface layer of the Valent, rolling, soil is grayish brown, loose fine sand about 4 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches.

Typically, the surface layer of the Valent, hilly, soil is grayish brown, loose fine sand about 3 inches thick. The underlying material is pale brown and very pale brown fine sand to a depth of more than 60 inches.

Included with this soil in mapping are small areas of Dailey; Els, calcareous; and Ipage soils. The included soils are in sandhill valleys. Dailey soils have a dark surface soil more than 10 inches thick. Els, calcareous, soils are somewhat poorly drained, and Ipage soils are moderately well drained. Included soils make up less than 10 percent of the unit.

Permeability is rapid in the Valent soil, and available water capacity is low. The organic matter content is low. Runoff is slow and medium in the rolling part and medium in the hilly part.

All of the areas of this soil support native grasses used as rangeland.

This soil is not suited to farming because of the slope, droughtiness, and the severe hazard of soil blowing.

If this soil is used for range, the climax vegetation is dominantly sand bluestem, little bluestem, prairie sandreed, and needleandthread. These species make up 65 percent or more of the total annual forage. Blue grama, switchgrass, sand lovegrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, sand lovegrass, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, blue grama, sand dropseed, sedges, and forbs in the rolling part and needleandthread, prairie sandreed, hairy grama, sand dropseed, sandhill muhly, sedges, and forbs in the hilly part. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, soil blowing is excessive and blowouts can form.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre on the rolling part and 0.6 animal unit month per acre on the hilly part. The stocking rate is determined by the percentage of each soil in the pasture. The range should be closely monitored during use and the stocking rates adjusted so that one soil does not become overgrazed. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing.

Small soapweed increases in abundance in areas of the range used only as summer pasture. It can be controlled by using the pasture as winter range. Blowouts can be stabilized in a few years by a planned grazing system. Steep banks should be sloped to a stable grade before they are revegetated. If fences are used to exclude livestock, shaping, seeding, and mulching the blowouts can hasten the reclamation process.

The Valent, rolling, part is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and soil blowing are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Because the soil is loose, trees should be planted in shallow furrows with as little disturbance of the soil as possible. Strips of sod or other vegetation is needed between the tree rows to control soil blowing. Seedlings can be damaged by high winds and covered by drifting sand. The undesirable grasses and weeds in the tree rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide. The Valent, hilly, part is not suited to the trees and shrubs planted in windbreaks because of the slope. A few areas may be suitable for the trees or shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

This soil is not suitable for sanitary facilities on the steep and very steep slopes. On the moderately steep slopes, land shaping and installing septic tank absorption fields on the contour are generally necessary for their proper operation. The poor filtering capacity can result in pollution of the ground water. Dwellings and buildings need to be properly designed so that they conform to the natural slope of the land, or the soil can be graded to a suitable gradient. Cutting

and filling are generally needed to provide a suitable grade for roads. Seeding the roadside after construction helps to stabilize the loose soil. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

The land capability units are VIe-5, dryland, for the Valent, rolling, soil and VIIe-5, dryland, for the Valent, hilly, soil. The rolling part is in the Sands range site and windbreak suitability group 7. The hilly part is in the Choppy Sands range site and windbreak suitability group 10.

VaG—Valent fine sand, hilly. This very deep, excessively drained soil is on dunes in the sandhills. Slopes range from 24 to 60 percent. The soil formed in eolian sand. Catsteps are common. Individual areas range from 80 to 2,000 acres in size.

Typically, the surface layer is grayish brown, loose fine sand about 3 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches.

Included with this soil in mapping are small, gently sloping areas. Included areas make up about 5 to 10 percent of the unit.

Permeability is rapid in the Valent soil, and available water capacity is low. The organic matter content is low. Runoff is medium.

All of this soil is used as rangeland.

This soil is not suited to farming because of the very steep slope.

If this soil is used as range, the climax vegetation is dominantly sand bluestem, little bluestem, switchgrass, prairie sandreed, and needleandthread. These species make up 80 percent or more of the total annual forage. Sand lovegrass, blue grama, sandhill muhly, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, sand lovegrass, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, prairie sandreed, hairy grama, sand dropseed, sandhill muhly, sedges, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, soil blowing is possible and blowouts can form.

If the range is in excellent condition, the suggested initial stocking rate is 0.6 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing.

This soil is not suited to the trees and shrubs planted in windbreaks because of the slope. A few areas may be suitable for the trees or shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

This soil generally is not suitable for sanitary facilities or dwellings and buildings because of the steep and very steep slopes. A suitable alternative site should be selected. Cutting and filling are generally needed to provide a suitable grade for roads. Seeding the roadside after construction helps to stabilize the loose soil. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

The land capability unit is VIIe-5, dryland; Choppy Sands range site; and windbreak suitability group 10.

VeB—Valent loamy fine sand, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, excessively drained soil is in sandhill valleys and in transitional areas bordering the sandhills. It formed in eolian sand. Individual areas range from 10 to 340 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 6 inches thick. The underlying material is light brownish gray, loose fine sand to a depth of more than 60 inches. In some places the surface layer is fine sand.

Included with this soil in mapping are small areas of Dailey, Jayem, and Tuthill soils. Dailey soils have a dark surface soil more than 10 inches thick and are lower on the landscape than the Valent soil. Jayem and Tuthill soils have more silt and clay in the profile than the Valent soil and are lower on the landscape. In a few areas the soil is gently sloping. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Valent soil, and available water capacity is low. The organic matter content is low. Runoff is slow. The water intake rate is very high.

Nearly all of the acreage of this soil is used as rangeland. The rest is used for irrigated crops.

This soil is not suited to dryland farming because of droughtiness and the hazard of soil blowing.

If irrigated by a sprinkler system, this soil is poorly suited to corn, small grains, alfalfa, and introduced grasses. It is too sandy for gravity irrigation systems. Frequent, light applications of water are needed. Soil blowing is the principal hazard. A system of conservation tillage, such as stubble mulching and ecofallow, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. Incorporating crop residue into the soil improves the organic matter content and fertility. Supplemental applications of nitrogen, phosphorus, zinc, and sulfur are needed for maximum crop

production. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone.

If this soil is used for range or native hay, the climax vegetation is dominantly prairie sandreed, sand bluestem, needleandthread, and little bluestem. These species make up 65 percent or more of the total annual forage. Blue grama, switchgrass, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, prairie sandreed, blue grama, Scribner panicum, sand dropseed, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, water erosion and soil blowing are excessive.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. This soil is generally the first to be overgrazed in a pasture that includes the Sands or Choppy Sands range sites. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain healthy and vigorous.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and soil blowing are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Because the soil is loose, trees should be planted in shallow furrows with as little disturbance of the soil as possible. Strips of sod or other vegetation is needed between the tree rows to control soil blowing. Seedlings can be damaged by high winds and covered by drifting sand. The undesirable grasses and weeds in the tree rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. This soil is generally suited to dwellings, buildings, and roads. Seeding the roadside after construction helps to stabilize the loose soil. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

The land capability units are VIe-5, dryland, and IVe-11, irrigated; Sandy range site; and windbreak suitability group 7.

VeD—Valent loamy fine sand, 3 to 9 percent slopes. This very deep, gently sloping and strongly sloping, excessively drained soil is on dunes in transitional areas bordering the sandhills. It formed in eolian sand. Individual areas range from 10 to 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 5 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches. In some places the surface layer is fine sand.

Included with this soil in mapping are small areas of Dailey, Jayem, and Tuthill soils. Dailey soils have a dark surface soil more than 10 inches thick and are lower on the landscape than the Valent soil. Jayem and Tuthill soils have more silt and clay in the profile than the Valent soil and are lower on the landscape. In a few areas the soil is very gently sloping. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Valent soil, and available water capacity is low. The organic matter content is low. Runoff is slow. The water intake rate is very high.

Nearly all of the acreage of this unit is used as rangeland. A few areas are used for irrigated crops.

This soil is not suited to dryland farming because of droughtiness and the hazard of soil blowing.

If irrigated by a sprinkler system, this soil is poorly suited to corn, small grains, alfalfa, and introduced grasses. It is too sandy for gravity irrigation systems. Frequent, light applications of water are needed. Soil blowing is the principal hazard. A system of conservation tillage, such as stubble mulching and ecofallow, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. Incorporating crop residue into the soil improves the organic matter content and fertility. Supplemental applications of nitrogen, phosphorus, zinc, and sulfur are needed for maximum crop production. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone.

If this soil is used as range or hayland, the climax vegetation is dominantly sand bluestem, little bluestem, prairie sandreed, and needleandthread. These species make up 65 percent or more of the total annual forage. Blue grama, switchgrass, sand lovegrass, sedges, forbs, and shrubs make up the rest. If subject to continuous heavy grazing, sand

bluestem, sand lovegrass, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, blue grama, sand dropseed, sedges, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, soil blowing is excessive and blowouts can form.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing or haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and soil blowing are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Because the soil is loose, trees should be planted in shallow furrows with as little disturbance of the soil as possible. Strips of sod or other vegetation is needed between the tree rows to control soil blowing. Seedlings can be damaged by high winds and covered by drifting sand. The undesirable grasses and weeds in the tree rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. This soil is generally suited to dwellings and roads. Buildings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. Seeding the roadside after construction helps to stabilize the loose soil. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

The land capability units are VIe-5, dryland, and IVe-11, irrigated; Sands range site; and windbreak suitability group 7.

VnD—Valentine fine sand, 3 to 9 percent slopes. This very deep, gently sloping and strongly sloping, excessively drained soil is on dunes in the sandhills. It formed in eolian sand. Areas range from 10 to 500 acres in size.

Typically, the surface layer is light brownish gray, loose fine sand about 4 inches thick. The underlying material is very pale brown fine sand to a depth of more than 60 inches. In a few places the surface layer is loamy fine sand.

Included with this soil in mapping are small areas of Ipage soils, which are lower on the landscape than the Valentine soil and are moderately well drained. Also included are small areas of very gently sloping soils. Included soils make up 10 to 15 percent of the unit.

Permeability is rapid in the Valentine soil, and available water capacity is low. The organic matter content is low. Runoff is slow. The water intake rate is very high.

Most of the acreage of this soil supports native grasses used for grazing. Some areas are used for irrigated crops.

This soil is not suited to dryland farming because of droughtiness and the hazard of soil blowing.

If irrigated by a sprinkler system, this soil is poorly suited to corn, small grains, alfalfa, and introduced grasses. It is too sandy for gravity irrigation systems. Frequent, light applications of water are needed. Soil blowing is the principal hazard. A system of conservation tillage, such as stubble mulching and ecofallow, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. Incorporating crop residue into the soil improves the organic matter content and fertility. Supplemental applications of nitrogen, phosphorus, zinc, and sulfur are needed for maximum crop production. The efficient use of irrigation water is a management concern because excessive amounts of water can leach plant nutrients below the root zone.

If this soil is used as range or hayland, the climax vegetation is dominantly sand bluestem, little bluestem, prairie sandreed, and needleandthread. These species make up 70 percent or more of the total annual forage. Blue grama, switchgrass, sand lovegrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, sand lovegrass, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, blue grama, sand dropseed, sedges, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, soil blowing is excessive and blowouts can form.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

This soil is suited to the trees and shrubs planted in

windbreaks. The lack of adequate seasonal rainfall and soil blowing are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Because the soil is loose, trees should be planted in shallow furrows with as little disturbance of the soil as possible. Strips of sod or other vegetation is needed between the tree rows to control soil blowing. Seedlings can be damaged by high winds and covered by drifting sand. The undesirable grasses and weeds in the tree rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. This soil is generally suited to dwellings and roads. Buildings should be designed so that they conform to the natural slope of the land, or the site should be graded to a suitable gradient. Seeding the roadside after construction helps to stabilize the loose soil. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

The land capability units are VIe-5, dryland, and IVe-12, irrigated; Sands range site; and windbreak suitability group 7.

VnE—Valentine fine sand, rolling. This very deep, excessively drained soil is on dunes in the sandhills. It formed in eolian sand. Slopes range from 9 to 24 percent. Areas range from 80 to 2,000 acres in size.

Typically, the surface layer is pale brown, loose fine sand about 6 inches thick. The underlying material is very pale brown fine sand to a depth of more than 60 inches.

Included with this soil in mapping are small areas of Ipage soils, which are lower on the landscape than the Valentine soil and are moderately well drained. Also included are small areas that have a slope of less than 9 percent or more than 24 percent. Included areas make up 5 to 10 percent of the unit.

Permeability is rapid in the Valentine soil, and available water capacity is low. The organic matter content is low. Runoff is slow and medium.

Nearly all of the areas of this soil support native grasses used for grazing. A few small areas on some of the gentler slopes are cut for hay.

This soil is not suited to farming because of the slope, droughtiness, and the severe hazard of soil blowing.

If this soil is used as range or hayland, the climax vegetation is dominantly sand bluestem, little bluestem, prairie sandreed, and needleandthread. These species make up 70 percent or more of the total annual forage. Blue grama, switchgrass, sand lovegrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, sand lovegrass, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, blue grama, sand dropseed, sedges, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, soil blowing is excessive and blowouts can form.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain vigorous and healthy.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and soil blowing are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Because the soil is loose, trees should be planted in shallow furrows with as little disturbance of the soil as possible. Strips of sod or other vegetation is needed between the tree rows to control soil blowing. Seedlings can be damaged by high winds and covered by drifting sand. The undesirable grasses and weeds in the tree rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

This soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. Land shaping and installing septic tank absorption fields on the contour are generally necessary for their proper operation. Dwellings and buildings need to be properly designed so that they conform to the natural slope of the land, or the soil can be graded to a suitable gradient. Cutting and filling are generally needed to provide a suitable grade for roads. Seeding the roadside after construction helps to stabilize the loose soil. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

The land capability unit is VIe-5, dryland; Sands range site; and windbreak suitability group 7.

VnF—Valentine complex, rolling and hilly. This very deep, excessively drained soil is on dunes in the sandhills. It formed in eolian sand. Individual areas range from 80 to several thousand acres in size. They consist of 55 to 80 percent Valentine fine sand, rolling, and 20 to 45 percent Valentine fine sand, hilly. Slopes range from 9 to 24 percent in the rolling part and 24 to 60 percent in the hilly part. Catsteps are common on the side slopes in the hilly part. These soils are so intermingled or mixed that separating them in mapping is not practical.

Typically, the surface layer of the Valentine, rolling, soil is pale brown, loose fine sand about 5 inches thick. The underlying material is very pale brown fine sand to a depth of more than 60 inches.

Typically, the surface layer of the Valentine, hilly, soil is very pale brown, loose fine sand about 4 inches thick. The underlying material is very pale brown fine sand to a depth of more than 60 inches.

Included with this soil in mapping are small areas of Ipage soils, which are lower on the landscape than the Valentine soil and are moderately well drained. Also included are small areas that have a slope of less than 9 percent. Included areas make up 5 to 10 percent of the unit.

Permeability is rapid in the Valentine soil, and available water capacity is low. The organic matter content is low. Runoff is slow and medium in the rolling part and medium in the hilly part.

All of the areas of this soil support native grasses used for grazing.

This soil is not suited to farming because of the slope, droughtiness, and the severe hazard of soil blowing.

If this soil is used as range or hayland, the climax vegetation is dominantly sand bluestem, little bluestem, prairie sandreed, and needleandthread. These species make up 70 percent or more of the total annual forage. Blue grama, switchgrass, sand lovegrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, sand lovegrass, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, blue grama, sand dropseed, sedges, and forbs in the rolling part and needleandthread, prairie sandreed, hairy grama, sand dropseed, sandhill muhly, sedges, and forbs in the hilly part. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, soil blowing is excessive and blowouts can form.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre in the rolling part and 0.6 animal unit month per acre in the hilly part. The stocking rate is determined by the percentage of each soil in the pasture. The range should be closely monitored during use and the stocking rates adjusted so that one soil does not become overgrazed. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing.

Small soapweed increases in abundance in areas of the range used only as summer pasture. It can be controlled by using the pasture as winter range. Blowouts can be stabilized in a few years by a planned grazing system. Steep banks should be sloped to a stable grade before they are revegetated. If fences are used to exclude livestock, shaping, seeding, and mulching the blowouts can hasten the reclamation process.

The Valentine, rolling, soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and soil blowing are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Because the soil is loose, trees should be planted in shallow furrows with as little disturbance of the soil as possible. Strips of sod or other vegetation is needed between the tree rows to control soil blowing. Seedlings can be damaged by high winds and covered by drifting sand. The undesirable grasses and weeds in the tree rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide. The Valentine, hilly, soil is not suited to the trees and shrubs planted in windbreaks because of the steep slope. A few areas may be suitable for the trees or shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

This soil is not suitable for sanitary facilities on the steep and very steep slopes. On the moderately steep slopes, land shaping and installing septic tank absorption fields on the contour are generally necessary for their proper operation. The poor filtering capacity can result in pollution of the ground water. Dwellings and buildings need to be properly designed so that they conform to the natural slope of the land, or the soil can be graded to a suitable gradient. Cutting and filling are generally needed to provide a suitable grade for roads. Seeding the roadside after construction helps to stabilize the loose soil. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

The land capability units are VIe-5, dryland, for the

Valentine, rolling, soil and VIIe-5, dryland, for the Valentine, hilly, soil. The rolling part is in the Sands range site and windbreak suitability group 7. The hilly part is in the Choppy Sands range site and windbreak suitability group 10.

VnG—Valentine fine sand, hilly. This very deep, excessively drained soil is on dunes in the sandhills. Slopes range from 24 to 60 percent. It formed in eolian sand. Catsteps are common. Individual areas range from 80 to 2,000 acres in size.

Typically, the surface layer is grayish brown, loose fine sand about 3 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches.

Included with this soil in mapping are small areas of Valentine soils that have slopes of less than 24 percent. Included soils make up about 5 to 10 percent of the unit.

Permeability is rapid in the Valentine soil, and available water capacity is low. The organic matter content is low. Runoff is medium.

All of the acreage of this soil supports native grasses used for grazing.

This soil is not suited to farming because of the very steep slope.

If this soil is used as range, the climax vegetation is dominantly sand bluestem, little bluestem, switchgrass, prairie sandreed, and needleandthread. These species make up 75 percent or more of the total annual forage. Sand lovegrass, blue grama, sandhill muhly, and forbs make up the rest. If subject to continuous heavy grazing, sand bluestem, sand lovegrass, little bluestem, and switchgrass decrease in abundance and are replaced by needleandthread, prairie sandreed, hairy grama, sand dropseed, sandhill muhly, sedges, and forbs. If overgrazing continues for many years, the native plants lose vigor and are unable to stabilize the site. As a result, soil blowing is possible and blowouts can form.

If the range is in excellent condition, the suggested initial stocking rate is 0.6 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing.

This soil is not suited to the trees and shrubs planted in windbreaks because of the slope. A few areas may be suitable for the trees or shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

This soil generally is not suitable for sanitary facilities because of the slope. A suitable alternative site should be selected. Dwellings and buildings need to be properly designed so that they conform to the natural slope of the land, or the soil can be graded to a suitable gradient. Cutting and filling are generally needed to provide a suitable grade for roads. Seeding the roadside after construction helps to stabilize the loose soil. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

The land capability unit is VIIe-5, dryland; Choppy Sands range site; and windbreak suitability group 10.

VsB—Vetal loamy fine sand, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, well drained soil is on foot slopes and in upland swales. It formed in loamy and sandy alluvium and eolian sediments. Areas range from 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 7 inches thick. The subsurface layer is very dark grayish brown, very friable fine sandy loam about 18 inches thick. The transitional layer is dark grayish brown, very friable fine sandy loam about 15 inches thick. The underlying material to a depth of 60 inches or more is grayish brown loamy fine sand. In some places the surface layer is fine sandy loam or loamy very fine sand. In other places the dark surface soil is less than 20 inches thick. In some areas the profile has more very fine sand and less silt.

Included with this soil in mapping are small areas of Dailey and Tuthill soils. The included soils have a dark surface soil less than 20 inches thick. Dailey soils have more sand throughout the profile than the Vetal soil and are somewhat excessively drained. These soils are higher on the landscape. Tuthill soils have more clay in the profile than the Vetal soil and are higher on the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Vetal soil, and available water capacity is moderate. The organic matter content is moderately low. Runoff is slow. The water intake rate is high.

Most of the acreage of this unit supports native grasses used for grazing. The rest is used mainly for dryland farming.

If dryland farmed, this soil is suited to small grains, alfalfa, and introduced grasses. Inadequate rainfall in summer generally limits the cultivated crops that can be grown. Soil blowing is the principal hazard in areas where the surface is not adequately protected by crops or crop residue. A system of conservation

tillage, such as stubble mulching and ecofallow, that keeps crop residue on the surface helps to control soil blowing and water erosion and conserve soil moisture. Stripcropping and annual cover crops help to control soil blowing. Returning crop residue to the soil helps to maintain the organic matter content and fertility and improves the water intake rate. Summer fallowing conserves soil moisture for use during the following growing season.

If irrigated by a sprinkler system, this soil is suited to corn, field beans, sugar beets, small grains, alfalfa, and introduced grasses. This soil is not suited to gravity irrigation systems because of the sandy surface layer and the high water intake rate. Soil blowing is the principal hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue into the soil helps improve the organic matter content and fertility. The efficient use of irrigation water is a management concern because excessive amounts of water leach plant nutrients below the root zone.

If this soil is used for range or native hay, the climax vegetation is dominantly prairie sandreed, blue grama, threadleaf sedge, and little bluestem. These species make up 75 percent or more of the total annual forage. Sand bluestem, needleandthread, switchgrass, sand lovegrass, western wheatgrass, sideoats grama, and forbs make up the rest.

If the range is in excellent condition, the suggested initial stocking rate is 0.7 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If this soil is used as hayland, the forage should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range. Mowing should be regulated so that the grasses remain healthy and vigorous.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and soil blowing are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Cultivation between the rows with conventional equipment can control the undesirable grasses and weeds in areas where strips of sod and cover crops are not used. The weeds and undesirable grasses in the tree rows can be controlled by the careful use of the appropriate kind of herbicide or hoeing by hand.

This soil is generally suited to septic tank absorption fields, dwellings, and building sites. A good surface drainage system can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. The sides of shallow excavations in this soil can cave in unless they are shored.

The land capability units are IIIe-5, dryland, and IIIe-10, irrigated; Sandy range site; and windbreak suitability group 5.

Vt—Vetal fine sandy loam, 0 to 2 percent slopes. This very deep, nearly level, well drained soil is on foot slopes and in upland swales. It formed in loamy and sandy alluvium and eolian sediments. Areas range from 5 to 250 acres in size.

Typically, the surface layer is dark gray, very friable fine sandy loam about 7 inches thick. The subsurface layer is very friable fine sandy loam about 24 inches thick. The upper part is dark gray, and the lower part is dark grayish brown. The transitional layer is grayish brown, very friable fine sandy loam about 12 inches thick. The underlying material is light gray, calcareous fine sand to a depth of 60 inches or more. In some places the surface layer is loamy very fine sand or very fine sandy loam. In other places the dark surface soil is less than 20 inches thick.

Included with this soil in mapping are small areas of Dailey, Jayem, and Tuthill soils. Dailey soils have more sand in the profile than the Vetal soil and are higher on the landscape. Jayem soils have a dark surface soil less than 20 inches thick and are higher on the landscape than the Vetal soil. Tuthill soils have more silt and clay in the upper part of the profile than the Vetal soil and are higher on the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is moderately rapid in the Vetal soil. Available water capacity is moderate. The organic matter content is moderately low. Runoff is slow. The water intake rate is moderately high.

Most of the acreage of this soil is dryland farmed. The rest mainly supports native grasses used for grazing and haying.

If dryland farmed, this soil is suited to small grains, alfalfa, and introduced grasses. Inadequate rainfall in summer generally limits the cultivated crops that can be grown. Soil blowing is the principal hazard in areas

where the surface is not protected by crops or crop residue. A system of conservation tillage, such as stubble mulching and ecofallow, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. Cover crops also help to control soil blowing. Returning crop residue to the soil helps to maintain the organic matter content and fertility and improves the water intake rate.

If irrigated, this soil is suited to corn, field beans, small grains, alfalfa, and introduced grasses. It is suited to sprinkler and gravity irrigation systems. Some land leveling is generally needed for gravity systems to ensure the uniform distribution of water. Soil blowing is the principal hazard. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. The use of cover crops during the winter also helps to control soil blowing. Incorporating crop residue into the soil improves the organic matter content and fertility. The efficient use of water is a management concern because excessive amounts of water can leach plant nutrients from the soil.

This soil is suited to introduced grasses used as pasture and hayland. These grasses can be rotated with crops. Such cool-season grasses as pubescent wheatgrass and intermediate wheatgrass can be seeded either alone or in a mixture with warm-season grasses, such as switchgrass or big bluestem, on dryland pasture and hayland. Such cool-season grasses as smooth brome or orchardgrass can be seeded either alone or in a mixture with legumes, such as alfalfa or cicer milkvetch, into irrigated pastures. Fertilization improves the growth and vigor of the grasses. Weeds can be controlled if the appropriate kind of herbicide is applied.

This soil is suited to range. A cover of range plants effectively controls soil blowing. Continuous heavy grazing by livestock or improper haying reduces the amount of protective cover and the quality of the native plants. Proper grazing use, timely deferments from grazing or haying, and a planned grazing system help to maintain or improve the condition of the native plants.

This soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and soil blowing are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Soil blowing can be controlled by maintaining strips of sod or cover crops between the tree rows. Cultivating between the rows with conventional equipment can control grasses and weeds in areas where strips of sod and cover crops are not used. The undesirable grasses and weeds in the tree rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

This soil is generally suited to septic tank absorption fields, dwellings, and buildings. A surface drainage system minimizes the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. The sides of shallow excavations can cave in unless they are shored.

The land capability units are IIe-3, dryland, and IIe-8, irrigated; Sandy range site; and windbreak suitability group 5.

WrB—Wildhorse fine sand, 0 to 3 percent slopes. This very deep, nearly level and very gently sloping, somewhat poorly drained soil is in sandhill valleys. It formed in eolian sand and sandy alluvium. Areas range from 20 to 300 acres in size.

Typically, the surface layer is grayish brown, very friable, calcareous, very strongly alkaline fine sand about 5 inches thick. The transitional layer is light brownish gray, calcareous, very strongly alkaline fine sand about 5 inches thick. The underlying material extends to a depth of 60 inches or more. It is light brownish gray, calcareous, very strongly alkaline fine sand in the upper part; light gray, calcareous, very strongly alkaline, mottled fine sand in the middle part; and light gray, strongly alkaline, mottled fine sand in the lower part. In some places the surface layer is loamy fine sand.

Included with this soil in mapping are small areas of Els, calcareous; Hoffland; Ipage; and Valent soils. The included soils are not high in content of sodium. Els, calcareous, soils are on similar landscapes as the Wildhorse soil. Hoffland soils are high in carbonates and are lower on the landscape than the Wildhorse soil. Ipage and Valent soils are better drained than the Wildhorse soil and are higher on the landscape. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Wildhorse soil. Available water capacity and organic matter content are low. Runoff is slow. The seasonal high water table ranges from a depth of 1.5 feet during wet years to 3.5 feet during dry years. The water table normally recedes to a depth of 4 or 5 feet in late summer. This soil has a high content of sodium.

All of the acreage of this soil supports native grasses used for grazing or haying.

This soil is not suited to farming because it has a high content of sodium.

If this soil is used as range or hayland, the climax vegetation is dominantly alkali sacaton, inland saltgrass, western wheatgrass, slender wheatgrass,

and switchgrass. These species make up 70 percent or more of the total annual forage. Foxtail barley, bluegrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, alkali sacaton, western wheatgrass, and switchgrass decrease in abundance and are replaced by inland saltgrass, blue grama, bluegrass, foxtail barley, sand dropseed, and alkali tolerant sedges. If overgrazing or improper haying continues for many years, inland saltgrass, blue grama, bluegrass, foxtail barley, alkali tolerant sedges, rushes, and forbs dominate the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. The alkalinity of the soil limits forage production and greatly influences the kinds of plants that grow. In some areas the very strongly alkaline soils support little or no vegetation and are subject to a severe hazard of soil blowing during dry periods. Careful management is needed to maintain the plant cover.

If this soil is used as hayland, mowing should be regulated so that the grasses remain vigorous.

This soil is not suited to the trees and shrubs planted in windbreaks because it has a high content of sodium. A few areas may be suitable for the trees or shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used.

Constructing septic tank absorption fields on fill material raises the fields a sufficient distance above the seasonal high water table. This soil readily absorbs but does not adequately filter the effluent from the absorption fields. The poor filtering capacity of this soil can result in pollution of the ground water. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving if the excavation is made during dry periods. Constructing dwellings and buildings on raised, well compacted fill material helps to overcome the wetness caused by the high water table and helps to prevent the damage caused by ponding. Constructing roads on suitable, well compacted fill material, providing adequate side ditches, and installing culverts help protect roads from the damage resulting from the wetness caused by the seasonal high water table. A good surface drainage system and a gravel moisture barrier in the subgrade can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

The land capability unit is VIs-1, dryland; Saline Subirrigated range site; and windbreak suitability group 10.

WsB—Wildhorse-Hoffland complex, 0 to 3 percent slopes. These soils are in sandhill valleys. The Wildhorse soil is very deep, nearly level and very gently sloping, and somewhat poorly drained, and the Hoffland soil is very deep, nearly level, and poorly drained. The Wildhorse soil formed in eolian sand and sandy alluvium, and the Hoffland soil formed in sandy alluvium. The Wildhorse soil is on the very gently sloping ridges, and the Hoffland soil is in the nearly level, low areas between the ridges (fig. 15). The Hoffland soil is subject to rare flooding. Areas range from 20 to 900 acres in size. They consist of 55 to 70 percent Wildhorse soil and 25 to 40 percent Hoffland soil. These soils are so intermingled or mixed that separating them in mapping is not practical.

Typically, the Wildhorse soil has a surface layer of light brownish gray, very friable, calcareous, very strongly alkaline fine sand about 6 inches thick. The underlying material is calcareous, very strongly alkaline fine sand to a depth of 60 inches or more. It is grayish brown in the upper part, light brownish gray in the middle part, and light brownish gray and mottled in the lower part. In some places the surface layer is loamy fine sand.

Typically, the Hoffland soil has a surface layer of gray, very friable, calcareous fine sandy loam about 4 inches thick. The subsurface layer is very friable, calcareous fine sandy loam about 7 inches thick. The upper part is gray, and the lower part is light brownish gray. The underlying material is light brownish gray and light gray fine sand to a depth of 60 inches or more. It is mottled in the upper part. In some places the surface layer is loam. In a few places the profile is calcareous throughout.

Included with these soils in mapping are small areas of Els, calcareous; Ipage; and Marlake soils. The included soils are not high in content of sodium. Els, calcareous, soils are on similar landscapes as the Wildhorse soil. Ipage soils are better drained than the Wildhorse and Hoffland soils and are slightly higher on the landscape. Marlake soils are very poorly drained and are lower on the landscape than the Wildhorse and Hoffland soils. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Wildhorse and Hoffland soils. The Wildhorse soil has low available water capacity and low organic matter content. The Hoffland

Figure 15.—A typical area of Wildhorse-Hoffland complex, 0 to 3 percent slopes. The nearly level Hoffland soil is on the lowest parts of the landscape. The Wildhorse soil is slightly higher on the landscape between areas of the Hoffland soil.

soil has low available water capacity and very high organic matter content. Runoff is slow on the Wildhorse soil and very slow on the Hoffland soil. The Wildhorse soil has a seasonal high water table that ranges from a depth of 1.5 feet during wet years to 3.5 feet during dry years. The Hoffland soil has a seasonal high water table that ranges from the surface during wet years to a depth of 1.5 feet during dry years. The Wildhorse soil has a high content of sodium.

These soils are used as rangeland and hayland.

These soils are not suited to use as cropland because of the high content of sodium in the Wildhorse soil and the wetness caused by the seasonal high water table in the Hoffland soil.

If these soils are used as range or hayland, the climax vegetation on the Wildhorse soil is dominantly alkali sacaton, inland saltgrass, western wheatgrass, slender wheatgrass, and switchgrass. These species make up 70 percent or more of the total annual forage. Foxtail barley, bluegrass, sedges, and forbs make up the rest. The climax vegetation on the Hoffland soil is dominantly big bluestem, indiangrass, prairie cordgrass, switchgrass, sedges, and rushes. These species make up 60 percent or more of the total annual forage. Bluegrass, slender wheatgrass, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, alkali sacaton, western wheatgrass, and switchgrass decrease in abundance on the Wildhorse soil and big bluestem, prairie cordgrass, switchgrass, and indiangrass decrease in abundance on the Hoffland soil. They are replaced by inland saltgrass, blue grama, bluegrass,

foxtail barley, sand dropseed, and alkali tolerant sedges on the Wildhorse soil and slender wheatgrass, western wheatgrass, plains muhly, and sedges on the Hoffland soil. Timothy, redtop, and red clover also increase in abundance if they have been overseeded. If overgrazing or improper haying continues for many years, inland saltgrass, blue grama, bluegrass, foxtail barley, alkali tolerant sedges, rushes, and forbs dominate the site on the Wildhorse soil, and bluegrass, western wheatgrass, sedges, rushes, and forbs dominate the site on the Hoffland soil.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre on the Wildhorse soil and 1.8 animal unit months per acre on the Hoffland soil. The stocking rate is determined by the percentage of each soil in the pasture. The range should be closely monitored during use and the stocking rates adjusted so that one soil does not become overgrazed. A planned grazing system that includes proper grazing use and timely deferments from grazing and haying helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities can result in a more uniform distribution of grazing. The alkalinity on the Wildhorse soil limits forage production and greatly influences the kinds of plants that grow. In some areas the very strongly alkaline soils support little or no vegetation and are subject to a severe hazard of soil blowing during dry periods. Careful management is needed to maintain the plant cover. During wet periods on the Hoffland soil, grazing and operating heavy machinery cause surface compaction and the formation of small mounds and ruts, which make grazing or harvesting hay difficult.

If these soils are used as hayland, mowing should be regulated so that the grasses remain vigorous. Large meadows can be divided into three sections and the sections mowed in rotation. The order in which the sections are mowed should be changed in successive years. After the ground is frozen, livestock can graze the Hoffland soil without damaging the meadows. They should be removed in the spring before the ground thaws and the water table reaches a high level.

The Wildhorse soil is generally not suited to the trees and shrubs planted in windbreaks because it has a high content of sodium. A few areas may be suitable for the trees or shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used. The Hoffland soil is suited to the trees and shrubs planted in windbreaks. The main limitation affecting the establishment of windbreaks is the wetness caused by the high water table. The species suitable for planting are those that can withstand the occasional wetness. Tilling and planting seedlings should be delayed until after the soil has begun to dry. Seedlings can survive and grow if competing vegetation between the tree rows is controlled by cultivation with conventional equipment. The undesirable grasses and weeds in the rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

The Hoffland soil is not suited to septic tank absorption fields and building sites because of the wetness and the flooding. A suitable alternative site should be selected. In areas of the Wildhorse soil, constructing septic tank absorption fields on fill material raises the fields a sufficient distance above the seasonal high water table. The Wildhorse soil readily absorbs but does not adequately filter the effluent from septic tank absorption fields. The poor filtering capacity can result in pollution of the ground water. Constructing dwellings and buildings on raised, well compacted fill material helps to overcome the wetness caused by the high water table and the rare flooding in areas of the Hoffland soil. Constructing roads on suitable, well compacted fill material, providing adequate side ditches, and installing culverts help protect roads from the damage caused by the wetness and the flooding. A good surface drainage system and a gravel moisture barrier in the subgrade can minimize the damage to roads caused by frost action in areas of the Wildhorse soil. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

The land capability units are VIs-1, dryland, for the Wildhorse soil and Vw-7, dryland, for the Hoffland soil. The Wildhorse soil is in the Saline Subirrigated range site and windbreak suitability group 10. The Hoffland soil is in the Wet Subirrigated range site and windbreak suitability group 2D.

WtB—Wildhorse-Ipage, calcareous complex, 0 to 3 percent slopes. These soils are in sandhill valleys. The Wildhorse soil is very deep, nearly level, and somewhat poorly drained, and the Ipage, calcareous, soil is very deep, very gently sloping, and moderately well drained. The Wildhorse soil formed in sandy alluvium and eolian sand. The Ipage, calcareous, soil formed in eolian sand. Areas range from 20 to 300 acres in size. They consist of 55 to 65 percent Wildhorse soil and 30 to 40 percent Ipage, calcareous, soil. These soils are so intermingled or mixed that separating them in mapping is not practical.

Typically, the Wildhorse soil has a surface layer of dark grayish brown, very friable, calcareous, very

strongly alkaline fine sand about 6 inches thick. The transitional layer is grayish brown, very friable, calcareous, very strongly alkaline loamy fine sand about 5 inches thick. The underlying material is calcareous, very strongly alkaline and strongly alkaline fine sand to a depth of 60 inches or more. It is light brownish gray and mottled in the upper part and grayish brown in the lower part. In some places the surface layer is loamy fine sand.

Typically, the Ipage, calcareous, soil has a surface layer of dark gray, loose, calcareous fine sand about 6 inches thick. The transitional layer is grayish brown, loose, calcareous fine sand about 8 inches thick. The underlying material is light gray, calcareous fine sand to a depth of 60 inches or more. In some areas the dark surface layer is more than 10 inches thick. In some places the surface layer is sand, loamy sand, or loamy fine sand. In other places the underlying material is stratified. In some areas the upper part of the profile is noncalcareous.

Included with these soils in mapping are small areas of Hoffland and Valent soils. Hoffland soils are poorly drained and are in low areas. Valent soils are excessively drained and are higher on the landscape than the Wildhorse and Ipage, calcareous, soils. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Wildhorse and Ipage, calcareous, soils. Both soils have low available water capacity and low organic matter content. Runoff is slow. The water intake rate is very high. The Wildhorse soil has a seasonal high water table that ranges from a depth of 1.5 feet during wet years to 3.5 feet during dry years. The Ipage, calcareous, soil has a seasonal high water table that ranges from a depth of 3 feet during wet years to 5 feet during dry years. The Wildhorse soil has a high content of sodium.

Nearly all of the acreage of these soils support native grasses used for grazing or haying. In a few cultivated areas sprinkler irrigation systems are used.

These soils are not suited to dry-farmed crops because of the high content of sodium in the Wildhorse soil and the droughtiness and the hazard of soil blowing in the Ipage, calcareous, soil.

The Wildhorse soil is not suited to irrigated crops because of the high content of sodium.

If irrigated by a sprinkler system, the Ipage, calcareous, soil is poorly suited to corn, alfalfa, and introduced grasses. It is too sandy for gravity irrigation systems. Because of the low available water capacity, frequent, light applications of irrigation water are needed. Soil blowing is a severe hazard if the surface is not protected by crops or crop residue. A system of conservation tillage, such as ecofallow and no-till, that keeps crop residue on the surface helps to control soil blowing and conserve soil moisture. The use of cover crops during the winter helps to control soil blowing. Returning crop residue to the soil helps improve organic matter content and fertility. The efficient use of irrigation water is a management concern because the applications of excessive amounts of water can leach plant nutrients.

If these soils are used as range or hayland, the climax vegetation on the Wildhorse soil is dominantly alkali sacaton, inland saltgrass, western wheatgrass, slender wheatgrass, and switchgrass. These species make up 70 percent or more of the total annual forage. Foxtail barley, bluegrass, sedges, and forbs make up the rest. The climax vegetation on the Ipage, calcareous, soil is dominantly sand bluestem, little bluestem, prairie sandreed, needleandthread, and switchgrass. These species make up 75 percent or more of the total annual forage. Blue grama, prairie junegrass, bluegrass, indiangrass, sedges, and forbs make up the rest. If subject to continuous heavy grazing or improperly harvested for hay, alkali sacaton, western wheatgrass, and switchgrass decrease in abundance on the Wildhorse soil and sand bluestem, indiangrass, little bluestem, and switchgrass decrease in abundance on the Ipage, calcareous, soil. They are replaced by inland saltgrass, blue grama, bluegrass, foxtail barley, sand dropseed, and alkali tolerant sedges on the Wildhorse soil and prairie sandreed, needleandthread, sand dropseed, blue grama, sedges, and forbs on the Ipage, calcareous, soil. If overgrazing or improper haying continues for many years, inland saltgrass, blue grama, bluegrass, foxtail barley, alkali tolerant sedges, rushes, and forbs dominate the site on the Wildhorse soil, and blue grama, sand dropseed, needleandthread, Scribner panicum, sedges, and forbs dominate the site on the Ipage, calcareous, soil. Under these conditions the native plants lose vigor and are unable to stabilize the site.

If the range is in excellent condition, the suggested initial stocking rate is 0.9 animal unit month per acre. The range should be closely monitored during use and the stocking rates adjusted so that one soil does not become overgrazed. A planned grazing system that includes proper grazing use, timely deferments from grazing and haying, and restricted use during wet periods helps to maintain or improve the range condition. Properly located fences and livestock watering and salting facilities result in a more uniform distribution of grazing. Areas previously used as cropland should be reseeded to a suitable grass mixture if they are used as range.

If these soils are used as hayland, mowing should be regulated so that the grasses remain vigorous. The

forage on the Ipage, calcareous, soil should be harvested only every other year. During the year the forage is not harvested, the hayland should be used only as fall or winter range.

The Wildhorse soil is not suited to the trees and shrubs planted in windbreaks because it has a high content of sodium. A few areas may be suitable for the trees or shrubs that enhance recreational areas and wildlife habitat and for forestation if the tolerant species are planted by hand or if other special management is used. The Ipage, calcareous, soil is suited to the trees and shrubs planted in windbreaks. The lack of adequate seasonal rainfall and soil blowing are the main hazards affecting young trees. Irrigation can provide supplemental moisture during periods of low rainfall. Because the soil is loose, trees should be planted in shallow furrows with as little disturbance of the soil as possible. Strips of sod or other vegetation is needed between the tree rows to control soil blowing. Seedlings can be damaged by high winds and covered by drifting sand. The undesirable grasses and weeds in the tree rows can be controlled by hoeing by hand, rototilling, or the careful use of the appropriate kind of herbicide.

Constructing septic tank absorption fields on fill material raises the fields a sufficient distance above the seasonal high water table. The poor filtering capacity can result in pollution of the ground water. These soils readily absorb but do not adequately filter the effluent from septic tank absorption fields. The Ipage, calcareous, soil is generally suited to sites for dwellings and buildings without basements. Constructing dwellings with basements on the Ipage, calcareous, soil and all building sites on the Wildhorse soil on raised, well compacted fill material helps to overcome the wetness caused by the high water table. A good surface drainage system and a gravel moisture barrier in the subgrade can minimize the damage to roads caused by frost action. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving if the excavation is made during dry periods.

The land capability units are VIs-1, dryland, for the Wildhorse soil and VIe-5, dryland, and IVe-12, irrigated, for the Ipage, calcareous, soil. The Wildhorse soil is in the Saline Subirrigated range site and windbreak suitability group 10. The Ipage, calcareous, soil is in the Sandy Lowland range site and windbreak suitability group 7.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

About 266,000 acres in the survey area, or nearly 17 percent of the total acreage, meets the soil requirements for prime farmland. Areas of this land are in the northern part of the county in associations 2, 4, 6, and 9, which are described under the heading "General Soil Map Units." The main crops grown on this land are corn, winter wheat, alfalfa, and dry, edible beans.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Soils that have hazards or limitations, such as a seasonal high water table, frequent flooding during the growing season, or an inadequate amount of rainfall, qualify as prime farmland only in areas where these hazards or limitations have been overcome by such measures as drainage, flood control, or irrigation. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have been overcome by corrective measures.

Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at (800) 457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

Nondiscrimination Policy

The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers, employees, and applicants for employment on the basis of race, color, national origin, age, disability, sex, gender identity, religion, reprisal, and where applicable, political beliefs, marital status, familial or parental status, sexual orientation, whether all or part of an individual's income is derived from any public assistance program, or protected genetic information. The Department prohibits discrimination in employment or in any program or activity conducted or funded by the Department. (Not all prohibited bases apply to all programs and/or employment activities.)

To File an Employment Complaint

If you wish to file an employment complaint, you must contact your agency's EEO Counselor (http://directives.sc.egov.usda.gov/33081.wba) within 45 days of the date of the alleged discriminatory act, event, or personnel action. Additional information can be found online at http://www.ascr.usda.gov/complaint_filing_file.html.

To File a Program Complaint

If you wish to file a Civil Rights program complaint of discrimination, complete the USDA Program Discrimination Complaint Form, found online at http://www.ascr.usda.gov/complaint_filing_cust.html or at any USDA office, or call (866) 632-9992 to request the form. You may also write a letter containing all of the information requested in the form. Send your completed complaint form or letter by mail to U.S. Department of Agriculture; Director, Office of Adjudication; 1400 Independence Avenue, S.W.; Washington, D.C. 20250-9419; by fax to (202) 690-7442; or by email to program.intake@usda.gov.

Persons with Disabilities

If you are deaf, are hard of hearing, or have speech disabilities and you wish to file either an EEO or program complaint, please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

If you have other disabilities and wish to file a program complaint, please see the contact information above. If you require alternative means of communication for program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

Supplemental Nutrition Assistance Program

For additional information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, call either the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish, or the State Information/Hotline Numbers (http://directives.sc.egov.usda.gov/33085.wba).

All Other Inquires

For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (http://directives.sc.egov.usda.gov/33086.wba).

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Roger A. Kanable, conservation agronomist, Natural Resources Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Natural Resources Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

According to Nebraska Agriculture Statistics, about 23 percent of the total land acreage in Sheridan County is used as cropland. The largest acreage is used for dryland winter wheat and fallow. The rest is used mainly for irrigated field beans and corn. About 20 percent of the cropland is irrigated. The potential of soils in the county for increased production of food is good. Soils that are in land capability classes I through IV are suited to dryland or irrigated crops.

Management for Dryland Crops

Good management practices for dryland crops are those that reduce the rate of runoff and the risk of water erosion and soil blowing, conserve soil moisture, and improve tilth. Most of the soils are suitable for crops. In many areas, however, erosion is a severe hazard and should be controlled by suitable conservation practices.

Level terraces, contour farming, grassed waterways, and a conservation tillage system help to control water erosion. Keeping crop residue on the surface or growing a protective plant cover helps to prevent sealing and crusting of the soil during and after heavy rains. The moisture supply is increased in winter because the stubble catches drifting snow.

Soil blowing is a hazard on nearly all of the tillable soils, especially during periods of below average rainfall. A conservation tillage system and wind stripcropping help to control soil blowing. Planting row crops on the more productive soils and planting hay, pasture plants, or close-growing crops, such as small

grain and alfalfa, on the steeper, more erodible soils help to control soil blowing and water erosion. In many areas only the proper use of the land can reduce the hazard of erosion.

An insufficient amount of rainfall is the main limitation affecting dryland crops in Sheridan County. A cropping system that conserves moisture and controls water erosion and soil blowing is needed. A cropping system is the sequence of crops grown on a field and the management needed to conserve soil and water. It should preserve tilth and fertility, maintain a protective plant cover, and control weeds, insects, and disease on soils used for dryland crops. The cropping system selected should be the one best suited to the soil. For example, a conservation tillage system that maintains 1,500 pounds per acre of small grain residue on the surface to protect the soil from water erosion and soil blowing is needed on Satanta fine sandy loam, 6 to 11 percent slopes. On Alliance loam, 0 to 1 percent slopes, however, 1,000 pounds of small grain residue protect the soil from erosion.

Preparing a seedbed helps to control weeds and provide a favorable growing medium for plants. If tillage is excessive, however, the granular structure in the surface breaks down and tilth deteriorates. Tillage should be kept at a minimum. Various methods are used to reduce tillage in the county. Examples of methods that are well suited to all of the common crops are a fallow system in which weeds are controlled by the use of herbicides rather than by tillage; a system in which the soil is tilled with disks or chisels, which keeps tillage at a minimum and keeps crop residue on the surface; and a stubble mulching system in which crop residue from winter wheat remains on the surface after the soil is tilled. Grass seed can be drilled into a cover of stubble without further seedbed preparation.

Additional nutrients are needed in some of the soils used for dryland crops. The kind and amount of fertilizer to be applied to the soils should be based on the results of soil tests and on the content of moisture in the soil at the time of application. If the subsoil is dry and the amount of rainfall is low, fertilizer should be applied at a slightly lower rate than that needed when the soil is moist. On all of the soils that are used for nonlegume crops, nitrogen fertilizer is beneficial. Phosphorus and zinc are commonly needed on the more eroded soils and in areas that are cut for terraces, diversions, or land leveling. The amount of fertilizer needed on soils used for dryland crops is smaller than the amount needed on soils used for irrigated crops because the plant population is lower. All plant nutrients should be applied in a manner to prevent contamination of surface water and ground water.

On the soils assigned to capability subclass IIe, such as Alliance loam, 1 to 3 percent slopes, the best management includes a cover of crop residue, wind stripcropping, applications of fertilizer or feedlot manure, selection of suitable crop varieties, and a planned crop rotation. On the soils assigned to capability subclass IIIe, such as Alliance loam, 3 to 6 percent slopes, the best management includes a cover of crop residue throughout the winter, wind stripcropping, terracing, and a conservation tillage system that leaves, per acre, about 3,000 pounds of corn or sorghum residue or 1,500 pounds of small grain residue on the surface after the crops are planted. If the slope is more than 10 percent, grasses and legumes are needed in the cropping sequence to help control water erosion. The conversion of cropland to pasture or hayland is an economic alternative on the soils assigned to land capability class IV.

Some of the soils in Sheridan County, such as Lodgepole soils, are subject to ponding. The crops selected for planting should be those that can grow in a wet soil.

Some of the soils, such as Beckton silt loam, 0 to 2 percent slopes, are saline or sodic and thus are unsuitable for many climatically adapted plants. Saline or sodic (alkali) conditions affect the kind and production of crops and forage plants. Crops and forage plants that have a good degree of salt tolerance can be grown. Barley and winter wheat are more tolerant than field beans or corn. Such forage species as tall wheatgrass and birdsfoot trefoil are more tolerant than alfalfa or orchardgrass. Applications of feedlot manure and commercial fertilizer, particularly phosphorus, help to overcome the low fertility of these soils. Gypsum and sulfur can be applied on a trial basis, but results in the field are commonly disappointing.

Applications of herbicide are effective in controlling weeds. The kind and amount applied, however, should be carefully controlled. The application rate should be determined by the colloidal clay and humus fraction of the soil, which is responsible for most of the chemical activity in the soil. Applications of a large amount of herbicide result in crop damage on sandy soils, which have a low content of colloidal clay, and on soils that have a moderately low or low content of organic matter. Applying herbicides according to the kind of soil can lessen the danger of crop damage. All herbicides should be applied in a manner that minimizes the risk of contamination to surface and ground water.

Management for Irrigated Crops

About 20 percent of the cropland in Sheridan County is irrigated. Corn and dry, edible beans are the principal irrigated crops. A smaller acreage is used for alfalfa hay, wheat, and sugar beets. Corn, beans, and sugar beets can be irrigated by the furrow or sprinkler method. Alfalfa can be irrigated by the border, contour ditch, corrugation, or sprinkler method. Wheat, which generally is grown in rotation with beans or corn, is irrigated by sprinkler systems. The irrigation water is drawn by wells or canals.

The management needed in irrigated areas includes selecting a proper cropping sequence; land leveling, which provides a proper grade for the even distribution of irrigation water; applying measures that conserve moisture and control water erosion; and ensuring that the rate at which water is applied does not exceed the intake rate of the soil.

The cropping sequence on soils that are well suited to irrigation is dominated by row crops. A crop rotation that includes different row crops, small grains, and alfalfa or grass helps to control the diseases and insects that are common if the same crop is grown year after year.

A gently sloping soil, such as Keith loam, 3 to 6 percent slopes, is subject to water erosion in areas where it is irrigated by furrows that run down the slope. Contour bench leveling or a combination of contour furrows and parallel terraces helps to control water erosion in these areas. In areas where a sprinkler system is used, terracing, contour farming, grassed waterways, and a conservation tillage system, which keeps crop residue on the surface, help to control water erosion and conserve water.

If an adequate amount of water is available, sprinklers are most effective on moderately coarse textured and coarse textured soils and can be used on the more sloping and nearly level soils. The sprinklers are either the center-pivot type, which revolves around a central point, or are sets of sprinklers installed at various locations in the field. The water can be applied at a rate that does not exceed the intake rate of the soil and thus result in excessive runoff. Because the water can be carefully controlled, sprinklers are effective in helping to establish new pastures on the moderately steep soils. In summer, however, much of the water is lost through evaporation. Keeping crop residue on the surface increases the intake rate and decreases the evaporation rate. Wind drift can result in an uneven distribution of water in some areas.

Soil holds only a limited amount of water. The loams in Sheridan County, for example, hold about 2 inches of available water per foot of soil depth. Thus, a soil that is 4 feet deep and is planted to a crop that has roots extending to that depth can hold about 8 inches of water available for that crop. Irrigation should begin when about half of the available water has been used by the crop. Applying the water at regular intervals helps to keep the soil moist throughout at all times. The interval varies according to the crop and the time of year.

A tailwater recovery pit at the end of a field that is furrow irrigated helps to trap runoff of excess irrigation tailwater. This water can then be pumped to the upper end of the field and used again. These pits increase the efficiency of the irrigation system and conserve the supply of underground water.

All of the soils in Nebraska are assigned to irrigation design groups, which are described in the Nebraska Irrigation Guide *(5)*. Arabic numerals indicate the irrigation design groups to which the soils are assigned.

Assistance in planning and designing an irrigation system is available through the local office of the Natural Resources Conservation Service or the county agricultural agent. Estimates of the cost of equipment can be obtained from dealers and manufacturers of irrigation equipment.

Managing Pasture and Hayland

Areas that are used for hay or pasture should be managed for maximum forage production. A rotation system that results in a uniform distribution of grazing is needed. Many forage plants are a good source of minerals, vitamins, protein, and other nutrients. A well managed pasture can provide a balanced ration throughout the growing season. Adding plant nutrients to the soil helps to obtain maximum production. The kinds and amounts of fertilizer should be determined by soil tests. If pastures are irrigated, a high level of management is needed.

A mixture of grasses and legumes can be grown in rotation with grain crops on many soils. The grasses and legumes improve tilth, increase the organic matter content, and help to control erosion. They are ideal as part of a conservation cropping system.

The most commonly grown grasses in areas of irrigated pasture in Sheridan County are smooth brome and orchardgrass. Other grasses and legumes that are adapted to irrigation in the county are intermediate wheatgrass, meadow brome, and creeping foxtail. Legumes that may have potential for forage production are birdsfoot trefoil and cicer milkvetch. Under a high level of management, irrigated pastures in the county can produce 750 to 900 pounds of forage per acre.

Grasses that have potential for forage production in areas of dryland pasture are intermediate wheatgrass,

pubescent wheatgrass, and western wheatgrass. Smooth brome grows well on the lower, wetter soils.

Grasses and legumes grown on both irrigated and dryland pasture and hayland require additional plant nutrients for maximum forage production. The kinds and amounts of fertilizer should be determined by soil tests.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good-quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, or for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial

drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 and IIIe-6.

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of the map units in this survey area is given in the section "Detailed Soil Map Units," in the yields table, and in the Interpretive Groups that follow the tables at the back of the survey.

Rangeland

Kenneth L. Hladek, range conservationist, Natural Resources Conservation Service, helped prepare this section.

Rangeland makes up about 70 percent of the agricultural land in Sheridan County. The largest acreages are in the Valent, Valent-Wildhorse, and Valent-Els, calcareous-Hoffland soil associations in about the southern half of the county (fig. 16). Larger ranching operations typically are dominant in these associations. The eastern part of the Sandhills area has predominantly dry valleys in contrast to wet valleys in the central and southwestern parts of the Sandhills.

Farms and ranches in the northern part of the county tend to be smaller and more diversified, with cash-grain and livestock operations more common. Rangeland throughout the county is used primarily for grazing by livestock and supports the production of native hay.

The raising of livestock, mainly cow and calf herds, is the most important agricultural enterprise in the county. The calves are sold in the fall as feeders. The range is generally grazed from late spring to early fall. The livestock spend the fall grazing the regrowth on native meadows or crop residue. At the end of the year many producers hold livestock on winter pastures near the ranch headquarters. Livestock are fed alfalfa, native hay, or both during the winter and early spring. The rangeland forage is often also supplemented with protein in fall and winter.

Some of the rangeland in the county is producing well below its forage potential because of past continuous heavy grazing. This is particularly true where stocking rates are tied to the amount of crop residue available for grazing in the fall. Poor grazing distribution, the encroachment of brush on uplands, and increased amounts of leafy spurge also contribute to a reduced production of forage on rangeland in the county.

This section can aid ranchers and conservationists in planning the management of rangeland in the county. It defines range sites, shows how range condition is evaluated, and describes planned grazing systems and other practices used in managing range and hayland for sustained forage production in the county.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 8 shows, for each soil that supports rangeland vegetation suitable for grazing, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as rangeland or are suited to use as rangeland are listed. An explanation of the column headings in table 8 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the

Figure 16.—A typical area of rangeland in the Valent association.

amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The main objective of range management is to maintain or improve the range to excellent condition. Proper range management is most important for the conservation of the soil, water, and plant resources in the county. The productivity of the range can be increased by such practices as proper grazing use, planned grazing systems, range seeding, and brush control. Proper management practices improve yields of desirable forage plants for grazing, reduce soil losses, and increase the potential for livestock production. They control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the

optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Proper Grazing Use

Proper grazing use is grazing at an intensity that maintains sufficient cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. It is the first and most important step of successful range management. Proper grazing use increases the vigor and reproduction potential of desirable plants, allows the accumulation of litter and mulch necessary to control erosion, and increases forage production. Proper grazing use on rangeland is the removal of half of the current year's growth, by weight, when the site is grazed throughout the growing season.

Proper grazing use generally is determined by the degree to which a key species is grazed in a key grazing area. The factors that influence proper grazing use include the stocking rate, distribution of livestock, and kind and class of livestock.

Stocking rates.—The stocking rate is the number of animals grazing in a particular pasture. To attain proper grazing use, stocking rates are calculated on the basis of animal units (AU) and animal unit months (AUM). An animal unit is generally considered to be one mature cow of about 1,000 pounds and a calf as old as 4 months of age, or their equivalent. An animal unit month is the amount of forage or feed necessary to sustain an animal unit for 1 month. Range sites and range condition are used to determine animal unit months for each pasture. Suggested initial stocking rates can then be calculated for individual pastures. The animal unit months for each range site in excellent condition are given for each soil in the "Detailed Soil Map Units" section of this survey. AUM values are lower for range sites in less than excellent condition.

Suggested initial stocking rates for rangeland are relatively easy to calculate for any given soil or range site. For example, Valent fine sand, rolling, which is in the Sands range site, has a suggested initial stocking rate of 0.7 AUM per acre when the site is in excellent condition. A 640-acre pasture in excellent condition would then be able to carry 0.7 x 640, or 448 animal units, for 1 month. If the pasture is to be grazed for 5 months, the suggested initial stocking rate would be 448 animal unit months divided by 5 months, or 90 animal units. Suggested initial stocking rates are based on the condition of the present plant community and the average annual forage production each range site is capable of producing. This production may be high or low for any given year. Because of the weather conditions, forage production may vary. Stocking rates are intended to be a starting point and should be changed as forage production or management systems change.

Distribution of Livestock.—The cattle need to be distributed throughout a pasture if proper range use is to be uniform. Livestock tend to graze in areas near water, roads, or trails and in areas of gentle relief. Distant corners of the pasture, steep terrain, and areas away from water are often only lightly grazed. Poor grazing distribution may be caused by too few watering places, or by having salt, shade, supplemental feed, and water in one location or in a poor location. Continued concentration of livestock causes severe use in localized parts of a pasture. As a result, some areas are subject to erosion. Uniform distribution is best achieved by careful placement of fences, salt, and water and by planned grazing systems.

Fences help to distribute livestock and provide more uniform grazing of forage if placed at correct locations. They also divide pastures for grazing systems and can be used to exclude livestock from blowouts and reseeded areas. Cross fences should be built to follow natural land features and range site boundaries where possible. More importantly, they should be planned so that all pastures have similar potential stocking rates. Efficiency in forage use should be considered along with convenience in operations when pasture size is determined. Generally, the smaller the pasture, the more efficient the use of forage by livestock.

Properly locating salt and minerals is one of the easiest and most economical methods of encouraging uniform use of forage in a pasture. Salt and minerals should be located away from water. Cattle do not need to drink immediately after consuming salt or minerals. They can be easily moved to areas of the pasture that are undergrazed and can be moved periodically during the grazing season so that a uniform distribution of grazing is achieved. In areas of the Valent soils, moving these locations each time the livestock are permitted to graze the pasture lessens the hazard of blowouts resulting from concentrations of livestock.

Properly locating watering facilities can result in the distribution of grazing. In the Valent association, water is often obtained from wells that use windmills for pumping. Dugouts can be used on the wetter range sites, and stock-water dams are in the heavier textured soil associations in the county. Watering facilities should be spaced at varying distances, depending on topography. If distances to water are

excessive, cattle tend to graze close to the water sources repeatedly rather than moving out to graze the pasture uniformly. For example, in areas of rough or hilly terrain, cattle should not have to travel more than half a mile to water. In the more level areas, the greatest distance to water should be about a mile.

Kind and Class of Livestock.—Management of rangeland depends on the kind and class of livestock. Cattle, sheep, and horses have different grazing habits and nutritional needs that affect the way range can best be managed for proper grazing use.

Cattle are the principal livestock raised in Sheridan County and are well suited to grazing the dominant range sites. Grazing habits also differ among classes of cattle. Yearlings tend to travel more within a pasture than cow-calf pairs. They also graze the steeper slopes and use a pasture more uniformly than cows with calves. Yearlings tend to trail along fence lines, however, which sometimes results in erosion. Cow-calf pairs generally graze more on the gentler slopes and stay closer to watering facilities than yearlings. As a result, grazing distribution may be more of a problem on pastures stocked with cow-calf pairs than on pastures stocked with yearlings. Horses and sheep are raised in the county but are few in number.

The general management techniques outlined in this section and in the "Detailed Soil Map Units" section apply mainly to cattle production. In areas where a different kind of livestock grazes the site, adjustments in management may be needed.

Range Condition

Range condition for any range site is the present state of the vegetation compared to its potential, or climax, vegetation. Climax vegetation is a stable plant community that represents the highest point of plant succession. It is the most productive combination of forage plants on rangeland and represents the highest potential in kind and amount of vegetation for a given range site. It maintains itself and changes little as long as the climate and soil remain stable and grazing is at a proper level.

The purpose of determining the range condition is to provide an approximate measure of the overall health of the plant community. More importantly, it provides a basis for predicting the degree of improvement possible under different kinds of management. Four range condition classes express the degree to which the composition of the present plant community has departed from that of the climax vegetation—excellent, good, fair, and poor.

All food that green plants use for maintenance, growth, and reproduction is manufactured in their leaves. Excessive removal of plant leaves during the growing season drastically affects the growth of both roots and shoots. Livestock graze selectively, removing more leaves from some plants than from others. This selective grazing varies according to the season of use and the kind and class of livestock. Various plants respond to continuous heavy grazing in different ways. Some decrease in abundance, some increase, and others not originally present may invade. Plant responses to grazing are used to classify range condition.

Decreaser species on a range site are those present in the original plant community that decrease in abundance if grazed closely and continuously during the growing season. *Increaser plants* are those in the original plant community that normally increase, up to a point, in abundance under continuous heavy grazing. They increase as the decreaser plants cover less of the site. *Invader plants* are not part of the original plant community. They begin growing in an area after the decreasers and increasers have been weakened or eliminated.

Once range condition is determined, it is important to know whether it is improving or deteriorating. This change or trend in range condition is helpful in planning adjustments in grazing use and management. Important factors affecting this trend are plant vigor, composition change, and reproduction of both the desirable and undesirable plant species.

The goal of range management should be an excellent range condition. The highest forage yields are obtained, on a sustained basis, when the range is in excellent condition and the trend is up. Under these circumstances, soil blowing and water erosion are kept at an acceptable level without artificial aids. Plants make optimum use of precipitation on rangeland in this condition. At the end of each map unit description under the heading "Detailed Soil Map Units," the soil or soils in that unit are assigned to appropriate range sites according to the kind and amount of vegetation that can be expected when the site is in excellent condition.

Deferred Grazing

Deferred grazing is the resting of grazing land for a prescribed period of time. The need for deferment is based on the range condition and range trend. To be beneficial, deferment should be for a minimum of 3 consecutive months and coincide with the critical growth periods of the key forage plants. These periods vary with grass species. Maximum benefit from deferment coincides with the food-storage period. For warm-season native grasses, this period occurs in late summer, from late July to early October. In some areas a short deferment of 3 months is all that is

needed, while in other areas two complete growing seasons of continuous rest may be needed before there is improvement. Generally, some grazing during the year is more beneficial than a complete yearlong deferment. Deferred pastures may be grazed after heavy frost in fall or early in spring, before the initiation of growth of the warm-season grasses. During periods of winter grazing, protein supplements should be made available to cattle to meet their nutritional needs.

Deferred grazing allows plants a rest period during critical times in their growth cycle. This period allows grasses to build vigor and to produce a mulch at the surface, thus improving water infiltration. This mulch also reduces the hazard of erosion. Deferred grazing encourages natural grass reseeding by allowing desirable species to set seed and spread vegetatively.

Where severe overgrazing has eliminated the native grasses, reseeding the range to adapted native grasses is the best method of native range restoration. Reseeding of native range, excluding old cropland fields, should be done only after careful evaluation.

Planned Grazing Systems

Planned grazing systems are an effective method of achieving higher forage production and livestock performance while controlling the hazard of erosion. In a planned grazing system, two or more pastures are alternately rested and grazed in a planned sequence over a period of years. Each pasture is rested sometime during the growing season. All livestock are removed from the pasture being rested. The pastures are grazed in a different sequence each year. Where the same pasture is not grazed at the same time each year, the plants are not close-cropped by livestock at the same stage of development every year, plant vigor and forage production are increased, and the plant community and range condition are improved. Planned grazing systems permit maximum and uniform use of forage and maintain rangeland productivity over a period of years.

Planned grazing systems maintain or speed up improvement in plant cover and result in the proper use of forage. They increase grazing efficiency by uniformly using all parts of the pasture. The rest periods built into a planned grazing system improve plant vigor, vegetative reproduction, and forage quality, thus increasing forage production. Planned grazing systems also help to buffer the adverse effects of drought and other climatic changes.

To be effective, planned grazing systems should be flexible and tailored to meet the needs of an individual rancher. Fences, watering facilities, range condition, range trend, range sites, kinds or classes of grazing animals, and economic factors are all important considerations in determining the best suited system for a particular operation. Grazing systems are dynamic and over a period of time should be modified to reflect improved plant vigor and forage production or changes in management needs.

The use of a planned grazing system, in time, can result in an increase in stocking rates because of improved plant production and quality. Planned grazing systems are also effective in controlling blowouts and may help to control parasites and disease among cattle.

Range Seeding

In some areas range management practices alone cannot restore a satisfactory cover of native vegetation. Old cultivated fields, "go-back" areas, and abandoned farmsteads should be restored by range seeding. Range seeding may also be required in severely overused areas where the vegetation has deteriorated to the point that it cannot respond to management practices.

Good stands of native grasses can be reestablished if the seedbed is properly prepared, adapted species of native grasses are selected, correct seeding practices are employed, and careful management is used after seeding. Range seeding is most successful when the seedbed is firm and has a mulch cover. A firm seedbed helps to ensure good soil-to-seed contact, which is essential for seedling development. The cover of mulch helps keep the soil moist, lowers the surface soil temperature, and reduces the hazard of erosion. A mulch cover can be provided by a temporary crop, such as grain sorghum.

Grass should be seeded directly into the cover crop stubble the following fall, winter, or spring. Avoiding tillage helps to ensure a firm seedbed. On soils that have a coarser textured surface layer that is subject to soil blowing, preparing the seedbed and planting the seed in strips over a period of several years or with a range interseeder can minimize the hazard of soil blowing.

Seeding mixtures should be of adapted native grasses that are present when the site is in excellent range condition. Consequently, appropriate grass mixtures vary according to soils and range sites. Use of a grass drill with depth bands assures proper placement of seeds at a uniform depth in the soil. On soils in the Sands and Choppy Sands range sites and on other soils where tillage for seedbed preparation would result in a severe hazard of soil blowing, a range interseeder should be used. Interseeders place the seed in the center of a shallow furrow without

disturbing the vegetation or the soil between the furrows and thus without increasing the hazard of erosion.

Generally, newly seeded areas should not be fully grazed until after the grass is established. Establishment may take from 2 to 4 years, depending on the grass species, the range site, the method of planting, and the weather. Initial grazing of newly seeded areas should be light. Limited early spring, late fall, or winter grazing may be desirable for weed control until the grass has become established. Proper grazing use and a planned grazing system can keep the range productive after the establishment period.

Additional information about appropriate grass mixtures, grassland drills, and planting dates for range seeding can be obtained from the Natural Resources Conservation Service or Natural Resources District offices.

Control of Blowouts

Blowouts occur on sandy soils, mainly in areas of the Valent association where the vegetation has been disturbed. Many blowouts in the sandhills result from the livestock trailing associated with continuous heavy grazing. The larger blowouts generally start at watering facilities because livestock generally concentrate near water. The smaller blowouts often form along trails or fence lines. Drought increases the chance of blowout formation.

When blowouts are not stabilized, they are likely to enlarge. The wind blows sand onto bordering areas and covers the vegetation. The result is an ever-enlarging area that is subject to severe soil blowing.

Many blowouts can be stabilized in 4 to 5 years by controlling grazing through a planned grazing system. Locating salting facilities and mineral supplements away from blowouts discourages the concentration of livestock in these areas. A planned grazing system is the most effective way to control blowouts.

When a planned grazing system is not feasible, reseeding may be necessary. Reseeding, however, may not be economically feasible. If blowouts are reseeded, steep banks around the edges may need to be shaped to a stable slope. A rapidly growing cover crop should be planted in the spring. An adapted native grass mixture is then drilled into the undisturbed stubble left from the crop. This residue helps to protect the surface soil from the wind, lowers the surface soil temperature, and helps to ensure a good, firm seedbed. If a cover crop is not practical, a mulch of native hay can be spread over the surface and anchored into the sand after seeding. Mulching helps to control the damage from blowing sand while the grasses become established. Once seeded, blowout areas should be fenced to exclude livestock until a desirable stand is obtained. Proper grazing use and a planned grazing system help to prevent reactivation of stabilized blowouts after the grasses are established.

Managing Native Hayland

A fairly sizable acreage of rangeland in Sheridan County is used for the production of native hay. Some hay is cut on soils that have a high water table. They are associated with the Subirrigated range site in the Beckton-Lute and Valent-Els, calcareous-Hoffland associations. In some areas hay is harvested on upland sites that are generally used for grazing. These hayfields are mainly in the Sandy Lowland, Sandy, or Sands range sites.

Production from wet meadows can be maintained or improved by proper management. In order to maintain strong plant vigor and high-quality forage plants, timely mowing is needed. If possible, grasses should be mowed from the boot stage to the emergence of seed heads. Mowing during this period permits adequate regrowth and carbohydrate storage in the plant roots before the first frost. A mowing height of no less than 3 inches helps to maintain high plant vigor and promotes rapid regrowth.

Meadows should not be grazed or hayed when the soil is wet or the water table is within a depth of 6 inches. Grazing or using heavy machinery during these periods results in the formation of small bogs, ruts, and mounds that cause mowing difficulty in later years. Meadows can be grazed without damage after the ground is frozen, but livestock need to be removed before the ground thaws and the soil becomes wet.

When hay is cut on the drier upland sites, it should be harvested only every other year. The year following cutting, harvesting should be deferred during the growing season and the hay should be used for fall or winter grazing if necessary. This management method allows the warm-season grasses to regain vigor and suppresses cool-season grasses and weeds. As on the wetter sites, the best time for mowing is just before the dominant grasses reach boot stage. Regulating mowing allows the desirable grasses to remain vigorous and healthy. Early mowing allows enough time for adequate plant regrowth. The regrowth also helps to hold snow on the surface in the winter and increase the supply of soil moisture.

Ranchers and livestock producers can obtain technical assistance in range and hayland management or improvement programs from the local offices of the Natural Resources Conservation Service or Natural Resources District.

Brush Control

Small soapweed, western snowberry, juniper, and smooth sumac are the main brush species in Sheridan County. Although not a major range problem at the present time, these plants encroach on the continuously heavily grazed range and reduce forage production and carrying capacity for livestock.

Yucca can generally be controlled by winter grazing. Feeding a cottonseed cake supplement in yucca-infested areas encourages cattle to browse the yucca. Winter grazing causes yucca to lose vigor. Some plants are broken off below the root crown when livestock feed in these areas. Applications of approved herbicides have limited effectiveness.

Western snowberry, smooth sumac, and juniper are invading prairie uplands in fairly large numbers in soil associations that are adjacent to the steep canyon areas. Western snowberry and smooth sumac can be best controlled by applications of approved herbicides. Treatment of western snowberry may need to be repeated during several consecutive years for complete control. Herbicide recommendations are available from the county extension agent or the local office of the Natural Resources Conservation Service.

Juniper is best controlled by cutting the trees at ground level by hand or with earthmoving equipment in areas where the slopes and topography are suitable. Follow-up treatment is not necessary if no green branches remain. Approved herbicides are effective in controlling eastern redcedar. Deferment of pastures after treatment helps to restore plant vigor and the quality of forage.

Recommendations can be obtained from the local office of the Natural Resources Conservation Service.

Native Woodland

Gary Kuhn, forester, Natural Resources Conservation Service, and Doak Nickerson, district forester, Nebraska Forest Service, helped prepare this section.

Ponderosa pine, which is representative of the Rocky Mountain forest type, is on the slopes and in the canyons of the Pine Ridge area in Sheridan County. About 85 percent, or 175,000 acres, of the forest land in the Pine Ridge area is under nonindustrial private ownership. The rest, or 20,000 acres, is owned by the Bureau of Land Management and the State of Nebraska. The Pine Ridge is a crescent-shaped geologic fault that extends from east to west across Sheridan, Dawes, and Sioux Counties. The topography of this area ranges from steep slopes and canyons to flat and gently rolling surrounding tablelands. The average annual precipitation ranges from 12 to 14 inches in Sioux County and from 16 to 18 inches in Sheridan County.

Before European settlement, the forest land in Sheridan County was more savannahlike because of natural fires or fires caused by the native inhabitants. Native grasses were dominant, but old growth stands of ponderosa pine were in scattered areas. Isolated, dense pockets of pine may have been on protected, north-facing slopes. Hardwood forests were only on the drainage bottoms. Quaking aspen was much more prevalent because of the fires. After European settlement, the fires were eliminated. Consequently, ponderosa pine forests began to expand and quaking aspen disappeared, resulting in the forest of today.

The timber industry harvesting began in the late 1800's. Sawtimber was cut into ties for the railroad lines that were expanding into the region. From the 1960's through the 1980's, most of the sawtimber was cut into rough dimension lumber for local markets.

Timber harvesting activities in the county have greatly increased today. Timber companies based in South Dakota buy and harvest timber from the Pine Ridge area for local, regional, and national markets. Products include rough dimension lumber, landscape ties, pulp chips, fuelwood, and slabs. A new woodburning energy boiler at Chadron State College utilizes sawmill residue and possibly logging residue from timber harvesting and thinning operations.

The forest land in Sheridan County contains some of the most productive sites for growing timber in the Pine Ridge area because of the higher rainfall and greater abundance of deep soils on the north aspects. Because the topography in the county is gentler than that in other parts of the Pine Ridge area, operating logging equipment is easier. Many areas, however, are practically inaccessible because of the steep, heavily dissected slopes. The cost of logging and the potential for soil erosion are greatly increased in these areas. Most logging roads have been poorly designed in the past. Excessive water erosion has caused many roads to turn into gullies. Establishing water bars and seeding roadbeds to grass can aid in stabilizing these areas.

Much of the pine forest in Sheridan County is unmanaged. Measures that improve timber stands, such as precommercial or commercial thinning, have not been applied. As a result, most of the pine stands are overstocked and the trees are not growing at their full potential. The current average annual growth is estimated at 25 cubic feet per acre. Through management, the average annual growth could possibly be increased to 40 cubic feet per acre. Ponderosa pine responds well to thinning if the stand is less than 80 years old. The average annual growth

can be doubled through thinning. For example, trees taking 12 years to produce 1 inch of diameter growth before thinning take only 6 years to produce 1 inch of diameter growth after thinning. The best pine sites are in areas on north aspects and on the bottom of draws, where the soils are deeper and more moisture is available for tree growth.

The ponderosa pine timber type is unique because it offers opportunities for the growth of both timber and grass on the same site. Unmanaged pine stands shade out desirable forage, resulting in limited livestock grazing potential. Timber management, however, allows sunlight onto the forest floor, increasing forage production (fig. 17). Studies of Black Hills pine stands have shown that forage production more than doubles after thinning. A good rule of thumb for tree spacing when a pine stand is thinned is that the average tree diameter plus 6 equals the average spacing in feet (D+6). If increased forage for livestock grazing is a primary objective, tree spacing can be greater (i.e., D+8 rather than D+6 spacing). For example, if the average diameter of 10 pine trees at d.b.h. (diameter at breast height) is determined to be 8 inches, a spacing of 14 feet (D+6) would result in the best timber growth. If forage production is important, however, a spacing of 16 feet (D+8) would be better.

The trees that remain after a stand is thinned should be the best trees of the stand. They have a fuller crown, appear more vigorous, and generally have a larger diameter than the trees to be removed, which are weaker, are deformed or suppressed, and have a smaller diameter.

Forest fire is a serious threat to the unmanaged pine forests in the county. Because of the lack of management, forest fuels have built up to dangerously high levels. Also, the threat of crown fires is serious because of overstocked stands with no air space between crowns. The major forest fires in the Pine Ridge area, such as the Ft. Robinson and Belmont fires of 1989, indicate that fire is a serious threat. Timber management can make these forests more fireproof than they are at present.

Forest pests generally are not a major problem in the county. Western gall rust is pronounced in some stands. The best treatment for this rust is the removal of infected trees during thinning or harvesting. Bark beetle damage has been insignificant. Ips beetles have killed pockets of weaker pine, but no Dendroctonus beetle outbreaks have occurred. Drought cycles and overstocked, stressed pine stands could allow the entry of these beetles. Dendroctonus beetles pose a more serious threat because they can attack and kill the larger, mature pine trees, resulting in an extreme fire hazard.

The hardwood riparian forests on private land in Sheridan County are generally in poor condition. This condition is primarily the result of excessive overgrazing by livestock, whereby all understory shrubs and the capacity for hardwood tree reproduction is destroyed. The areas of hardwoods along drainageways are used as calving and feeding sites in the spring and are also overgrazed during the green-up periods of cool-season grasses in spring and fall. These areas are vital to wildlife and water quality. Livestock grazing should be controlled if the areas are to recover.

A forest stewardship program in Nebraska can address the proper management of ponderosa pine and hardwood riparian forests. Multiple benefits can result from timber and livestock grazing management.

Woodland Suitability Groups

To assist in planning the management of woodland in Sheridan County, soils have been grouped into four woodland suitability groups, which are shown in table 9 and described in the text. Each group is made up of soils that produce similar kinds and amounts of wood crops and that require similar management.

For management purposes, soil depth (the effective rooting depth to bedrock or an impenetrable layer), slope position (distance up the slope as a percentage of total slope length), slope class, and aspect are used to determine the potential productivity. In growth studies conducted in the Black Hills of South Dakota, the Forest Service has found that these variables are important in determining the site index of ponderosa pine.

Table 9 lists the potential productivity of the soils in each woodland suitability group and rates the hazards and limitations that affect management.

The site index shown in table 9 indicates productivity. It expresses the average height of the taller trees in a stand at a specified age. In table 9, the site index is the height, in feet, of ponderosa pine at 100 years of age.

The increments of periodic annual growth shown in table 9 are expressed in cubic feet for stands at 80 years of age. These yields are based on Forest Service studies on managed, even-aged stands of ponderosa pine in the Black Hills. In a managed stand where ponderosa pine is 80 years old and the soil has a site index of 70, the merchantable volume of wood products added each year would be about 65 cubic feet per acre. The conversion factors at the bottom of table 9 indicate that this amounts to about seven-tenths of a cord, or 390 board feet per acre per year. This is approximately double the increase in volume

Figure 17.—Thinning stands of pines allows more room for the remaining trees to grow and also increases forage production.

for the same period for a stand of the same age on a soil that has a site index of 55.

Woodland Suitability Group 1

Only the Ponderosa soils on north and east aspects are in this group. The moist phase of the Ponderosa soils occurs in Sheridan County because of the higher average annual precipitation, which is about 17 inches. The Ponderosa soils are mainly on the lower half of the total slope length. Slopes range from 3 to 60 percent. The soils are very deep. They have an effective rooting depth of well over 40 inches. The site index for ponderosa pine ranges from 70 to 80. Ponderosa pine grows better on these soils than on soils in the other groups. Timber management opportunities also are better in this group. The hazard of erosion and equipment limitations are severe where slopes are more than 30 percent. The native understory vegetation includes ponderosa pine, Oregongrape, skunkbush sumac, chokecherry, golden currant, Rocky Mountain maple, western snowberry, green ash, and horizontal juniper.

Woodland Suitability Group 2

The Canyon and Tassel soils on north and east aspects are in this group. They are on side slopes and ridgetops. Slopes range from 3 to 70 percent. These soils are mainly on the upper half of the total slope length. The major limiting factor affecting tree growth is soil depth. The effective rooting depth is less than 20 inches. The site index for ponderosa pine ranges from 50 to 59. Overstocked stands of ponderosa pine are common. Timber stand improvement activities, such as thinning, can increase the vigor and growth rates of the better trees, reduce the hazard of fire, and increase understory forage production. The hazard of

erosion and equipment limitations are severe where slopes are more than 30 percent. The native understory vegetation includes ponderosa pine, Oregongrape, skunkbush sumac, golden currant, western snowberry, Rocky Mountain maple, Rocky Mountain juniper, chokecherry, and horizontal juniper. The percentage of cool- and warm-season grasses is higher in open areas.

Woodland Suitability Group 3

The Ponderosa soils on the south and west aspects are in this group. They are on broad ridgetops and side slopes. Slopes range from 0 to 60 percent. The major limitation affecting tree growth is soil moisture because of the drier site conditions characteristic of south- and west-facing exposures. The productivity for trees is low or moderate. The site index for ponderosa pine ranges from 40 to 49. The potential for timber management is low because of scattered open stands of pine. Areas of this group are ideal for livestock grazing because the soils are deep and grasses are dominant in the understory. These areas are also well suited to wildlife habitat and recreational uses.

Woodland Suitability Group 4

The Canyon and Tassel soils on the south- and west-facing slopes are in this group. Slopes range from 0 to 70 percent. Soil depth is less than 20 inches. Because of the shallow soils and hot, dry site conditions, tree growth and the potential for timber management are extremely low. The site index for ponderosa pine is less than 40. Only scattered pine trees of low quality grow on these soils. The vegetation is dominantly a mixture of cool- and warm-season grasses. These soils are better suited to livestock grazing, wildlife habitat, and watershed protection than to timber.

Windbreaks and Environmental Plantings

Gary Kuhn, forester, Natural Resources Conservation Service, and Doak Nickerson, district forester, Nebraska Forest Service, helped prepare this section.

Sheridan County has a strong history of tree planting. When the area was being settled in the 1880's, one of the original tree planters was Jules Sandoz, a pioneer who had a great appreciation of trees. Hackberry, cottonwood, ash, fruit trees, and shrubs that he planted remain today as a living monument at his original homestead on the Niobrara River. His legacy still thrives on the farms and ranches in the county.

Sheridan County has some of the best windbreaks in the Nebraska Panhandle. These plantings are mainly classified as farmstead and livestock windbreaks. Most of these windbreaks are 3 to 5 rows wide with a combination of species, including eastern redcedar, ponderosa pine, Siberian elm, honeylocust, hackberry, green ash, plum, chokecherry, and caragana, all of which complement each other in multirow windbreaks.

Many of these good belts were planted in the 1950's and 1960's and, if managed correctly, will provide many more years of protection. Because the belts had good weed and grass control during the first 3 to 5 years of establishment, they have continuity with very few gaps. Also, these belts have shown very satisfactory growth rates for the precipitation zone. Active replanting that complemented good maintenance took place.

Some of the older belts from 30 to 50 years old are in poor condition. For example, windbreaks primarily made up of Siberian elm are in poor vigor, are overcrowded, do not have an evergreen or shrub component, and have big gaps. Most of the older belts are plagued by two critical problems. The belts have become sodbound from the encroachment of cool-season grasses, such as smooth brome or western wheatgrass. These grasses generally are adjacent to windbreaks near road ditches or are in areas of rangeland or pasture. They can quickly invade windbreaks and severely compete for moisture and nutrients. These sodbound belts are presently declining. The other critical problem is livestock grazing. Because fences are in total disrepair or are absent altogether, livestock have been allowed to graze in these belts, heavily in some places. The results are belts that have a pronounced "browse line," the complete absence of regeneration of trees and shrubs, and severe soil compaction because of trampling. Also, the invasion of cool-season grasses was increased because of the grazing disturbance within the windbreak.

Within the past ten years many windbreaks have been planted in Sheridan County. These belts are showing excellent survival and growth, which can be attributed primarily to an effective weed control program provided by the Upper Niobrara-White Natural Resource District. This program started about ten years ago and has increased dramatically because of the demands of farmers and ranchers.

In Sheridan County, however, the effort to establish field windbreaks can be accelerated. Field windbreaks can protect livestock and farmsteads. Establishing field windbreaks is a conservation concept that has not been considered. Properly located field windbreaks can help to control wind erosion, protect such crops as winter wheat from winter kill, trap and hold snow to

increase the soil moisture content for crop use, and provide additional wildlife habitat. In designing field windbreaks, modern designs need to be used. Specifically, these designs require no more than 2 rows, or 3 rows if wildlife habitat is an objective. One or two rows can be planted on the field borders. To protect winter wheat these windbreaks should be established on the north and west borders. Very little land is taken out of production, and farming systems would not have to change within the field. Excellent tree and shrub species for use in these windbreaks include eastern redcedar, Rocky Mountain juniper, ponderosa pine, caragana, skunkbush sumac, honeylocust, and green ash. Once field borders are established and providing good protection, landowners may be more willing to plant a system of field windbreaks.

In figure 18, the arrow indicates the wind direction, and the percentages indicate the wind reduction at distances (H) behind the windbreak. "H" is the height of the barrier. For example, a one-row planting of eastern redcedar that averages 25 feet tall reduces wind velocity by about 50 percent at 250 feet (10H), and some reduction of the wind would extend to as much as 500 feet (20H). Crop and soil protection, crop production, and snow accumulation are enhanced in this zone of wind reduction. Generally, the protected area extends 10 to 12 times the height of the windbreak on the leeward side and 3 to 5 times on the windward side. Beneficial microclimate changes, such as increased soil moisture, soil temperature, air temperature during the day, and relative humidity, occur within the protected area. Wind speed and evaporation are decreased. The overall result is an increase in crop yields in the protected area.

Another concern is the need for renovation in the older windbreaks (30 to 50 years old). Many of the older Siberian elm windbreaks could be easily renovated by plantings of supplemental conifers on the upwind or downwind side. In many areas where the landowner does not want to lose the marginal protection provided by Siberian elm windbreaks, renovation is taking place. Eventually, the dead and dying Siberian elm windbreaks can be removed as the supplemental conifer plantings mature. These supplemental plantings outside the existing belts have more application than a conifer component within the existing belts because of competition from deciduous trees and limited rainfall.

Eliminating brome or wheatgrass is needed in many of the windbreaks in order to release the trees. Applying postemergent herbicides would be the most practical method of weed control since tillage would be difficult because of tight spacings and branches. Also, installing or repairing fences helps to control livestock grazing. The exclusion of livestock would eliminate the further destruction of low-level density and reproduction of trees and shrubs.

Thinning and row removal and replacement are other renovation methods that can be used. Thinning is used only in situations where a belt is overstocked and tree removal would create more growing space for the remaining trees. Most of the belts in Sheridan County date from the 1930's onward and have satisfactory tree spacing. The removal and replacement of the tree rows are renovation alternatives when additional space for supplemental plantings is limited. Entire rows are removed and are replaced by new plantings. A good rule to follow when using this method is "for every two rows removed, only one row is replanted." This allows ample room for the new plantings and also for weed control.

Site preparation is the most important factor to consider before new windbreaks are established. The information in table 10, along with the 6 footnotes below the table, can aid in selecting the proper site preparation method. Site preparation stores moisture and controls weeds before the trees or shrubs are planted. It is extremely important in arid climates, such as that in Sheridan County. For example, if a windbreak is to be planted in a level area of cropland on a sandy soil, site preparation would involve sowing a cover crop in late summer if the soil is bare during the winter and planting directly into the soil or the cover crop without destroying the existing crop residue. Footnotes 2 and 3 in table 10 would also apply.

A commitment of 3 to 5 years of weed and grass control is needed for new windbreak plantings. Weeds can be controlled by mechanical methods, by chemical methods, or by the use of synthetic weed barriers. Windbreak design features are influenced by the weed control method that is used.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely

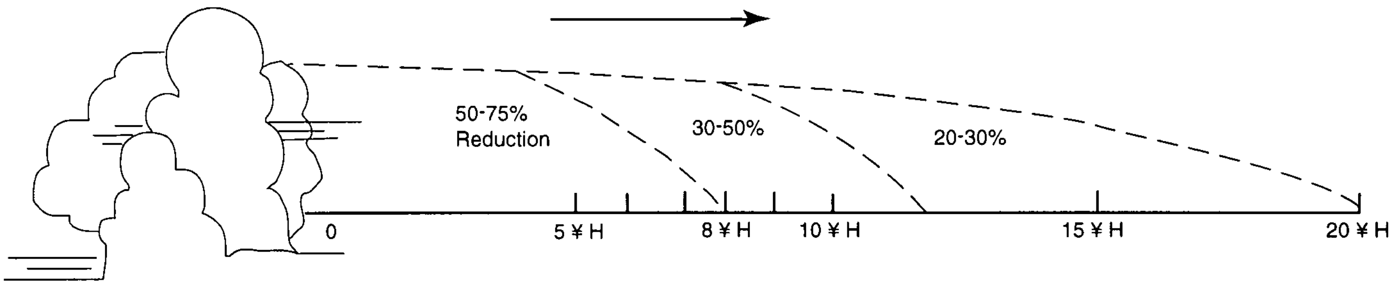


Figure 18.—Zones of wind reduction on the leeward side of a windbreak.

spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 11 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 11 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from the local office of the Natural Resources Conservation Service or of the Cooperative Extension Service or from a commercial nursery.

Recreation

Gerald E. Jasmer, wildlife biologist, Natural Resources Conservation Service, helped prepare this section.

A good diversity of quality recreational activities is available in Sheridan County. Opportunities for picnicking, hiking, swimming, hunting, fishing, camping, and golfing are plentiful.

Because of the many natural, scenic, and historical sites in the county, sightseeing can be particularly enjoyable *(3)*. Several roadside historical markers point out the rich history of the area. One marker concerns the author Mari Sandoz. Miss Sandoz is probably best known for her book, "Old Jules," an historical account of her father's experiences in Sheridan County from 1884 through 1928. The Mari Sandoz State Historical Marker is 20 miles south of Gordon along Nebraska Highway 27, near the Sandoz orchard and the Mari Sandoz grave site. Roadside picnic and playground facilities are also available at the marker.

A marker entitled "Opening the Sandhills" is east of Gordon. This marker describes the early years of ranching in the Sandhills, described as an area that "would not support cattle" and considered "dangerous for humans."

A third historical marker is in the southern part of the county along Nebraska Highway 2. This marker describes the potash plants that were near Antioch. Potash is important for the manufacture of fertilizer and was derived from the alkaline lakes in the area. For a time during World War One, Antioch was the leading potash center in the United States.

Additional unmarked historic sites include the Old Spotted Tail Agency, Camp Sheridan, the Sawyer Trail, and Fort Nendell.

Three State-owned areas provide significant recreational opportunities. Walgren Lake State Recreation Area is made up of a 50-acre lake and about 80 adjacent acres southeast of Hay Springs. Fishing, picnicking, hiking, hunting, camping, and unsupervised swimming are available. Facilities at Walgren Lake include a picnic shelter, boat dock, restrooms, and playground equipment.

Smith Lake State Wildlife Management Area is about 20 miles south of Rushville. Although managed primarily for wildlife, this 641-acre sandhill lake area has campsites, restrooms, and a scenic backdrop for picnickers. Hiking, fishing, hunting, and unsupervised swimming are also available.

Metcalf State Wildlife Management Area, which is more than 2,400 acres, is the largest public recreation area in the county. It is on the Pine Ridge escarpment about 12 miles north of Hay Springs. It is an area of fairly rough ponderosa pine forest that is ideal for hiking and big game hunting.

The 1988 Nebraska State Comprehensive Outdoor Recreation Plan (recreation reference A) lists 165 acres of municipal recreational facilities in Sheridan County. Nine-hole golf courses are at Rushville, Gordon, and Hay Springs. These communities also

maintain playgrounds, picnic areas, and swimming pools. Campsites are available in Gordon.

Hunting for big game, small game, and waterfowl are popular recreational activities in Sheridan County. Small game includes both birds and mammals. Sharp-tailed grouse, ringnecked pheasant, cottontail rabbit, coyote, raccoon, and fox squirrel are the major small game species subject to harvest. Mourning dove are throughout the county and are hunted in early fall. Big game species that are hunted in the county are white-tailed deer, mule deer, pronghorn antelope, and wild turkey. Waterfowl includes numerous species of ducks and geese. Early hunting for waterfowl can be quite successful. Hunting for waterfowl ends in late fall when marshes and lakes in the county become covered by ice. Selected springs, streams, and the Niobrara River (locally known as the Running Water) can provide opportunities for hunting waterfowl into the winter. Hunting occurs during regular seasons in public areas that are open to hunting and on private lands with permission of the landowner.

Fishing is one of the most popular recreational activities in Nebraska. Walgren Lake and Smith Lake provide the only public fishing in Sheridan County. Smith Lake was renovated in 1987 and should provide good fishing for the next decade or more. Largemouth bass, bluegill, yellow perch, walleye, and tiger musky were stocked. Walgren Lake has these five species, as well as black crappie. Some privately owned lakes in the county contain largemouth bass and bluegill or occasionally northern pike and yellow perch. Limited trout fishing occurs in a few streams on private land. Brown trout of catchable size are regularly stocked in Pine, Larabee, and White Clay Creeks and occasionally in Deer Creek. Permission must be obtained from the landowner before fishing on private land.

The soils of the survey area are rated in table 12 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 12, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or a combination of these measures.

The information in table 12 can be supplemented by other information in the survey, for example, interpretations for septic tank absorption fields in table 15 and interpretations for dwellings without basements and for local roads and streets in table 14.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils are gently sloping and are not wet or subject to flooding during the period of use. The surface has few or no stones, absorbs rainfall readily but remains firm, and is not dusty when dry. Steep slopes can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is firm after rains and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or gravel should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Technical assistance in improving habitat for fish and wildlife and in designing recreational facilities is available at the local field office of the Natural Resources Conservation Service in Rushville.

Wildlife Habitat

Gerald E. Jasmer, wildlife biologist, Natural Resources Conservation Service, helped prepare this section.

Sheridan County has a wide variety of habitat for openland, wetland, woodland, and rangeland wildlife species.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the availability of natural water sources and the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water.

In table 13, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the degree of management needed for each habitat element.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, and dry, edible beans.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are intermediate wheatgrass, smooth brome, crested wheatgrass, clovers, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are switchgrass, goldenrod, western wheatgrass, sunflower, and ragweed.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are hackberry, cottonwood, willow, green ash, boxelder, Russian-olive, and honeylocust.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are ponderosa pine, blue spruce, eastern redcedar, and Rocky Mountain juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of fruit producing shrubs that are suitable for planting on soils rated *good* are American plum, skunkbush sumac, chokecherry, silver buffaloberry, and crabapple.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, prairie cordgrass, rushes, sedges, cattails, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if

the shallow water areas are to be developed. Examples of shallow water areas are marshes, shallow dugouts, ditches, and ponds.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, shrubs, herbs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife that are attracted to these areas include ring-necked pheasant, mourning dove, meadowlark, killdeer, badger, and skunk.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous woody plants and associated shrubs, grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, deer, porcupine, squirrel, raccoon, songbirds, and woodpeckers.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shorebirds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include pronghorn antelope, mule deer, coyote, prairie dog, bull snake, upland plover, sharp-tailed grouse, and greater prairie chicken.

The two major land resource areas in Sheridan County are the Mixed Sandy and Silty Tableland and the Nebraska Sandhills. These areas often have different potential for wildlife habitat. In these major land resource areas, 16 soil associations have been identified. Many of these associations can be grouped according to the wildlife habitat and wildlife species they support. Each soil association and its relation to wildlife are discussed in the following paragraphs.

The Valent association is almost entirely rangeland that is used for grazing. The good-quality rangeland habitat in this association is chiefly made up of native grasses and forbs and scattered woody plants. Sharp-tailed grouse, coyote, mule deer, jackrabbits, small rodents, meadowlark, horned lark, and occasional pronghorn antelope are typical wildlife species in this association.

The Valent-Wildhorse and Valent-Tryon-Ipage associations are also used for grazing. However, the broad, lush valleys are often cut for hay. Good-quality rangeland and wetland habitat are abundant. The wet meadows are important habitat for grouse and also support many species of mice, voles, and other small rodents. Many of the shallow lakes are alkaline and support large numbers of brine shrimp and brine flies, which in turn support large numbers of waterfowl and shorebirds. Mink and muskrat are common on wetlands vegetated by cattails, bulrush, and reeds.

The Tuthill-Keya, Satanta-Canyon-Busher, Oglala-Alliance-Canyon, and Thirtynine-Kadoka-Epping associations support a mixture of agricultural uses. Rangeland, pasture, hayland, and cropland are common land uses. The primary crops are winter wheat, alfalfa, and some irrigated corn. These associations provide habitat for a variety of openland wildlife, such as pheasant, cottontail rabbit, and mourning dove. Water areas, shrubs, and undisturbed nesting areas are limitations affecting wildlife habitat.

The Keith, gravelly substratum-Bridget-Johnstown association also supports a mixture of agricultural uses. Much of this association, however, is used for the production of irrigated corn. This area provides abundant openland wildlife habitat, particularly for pheasants. Irrigation canals and their adjacent grassy borders provide some of the habitat elements that are limited in the other associations.

The Orpha-Calamus-Rock outcrop association is the only association in the Niobrara River valley. It is on bottom land and side slopes. This association provides a diversity of habitat types that support a rich mixture of wildlife. Shallow water areas, flowing streams, wetlands, shrubs, hardwoods, coniferous trees, and wild herbaceous plants are in the valley. The most common plant species in the area are chokecherry, American plum, indigobush, wild grape, snowberry, cottonwood, willow, ponderosa pine, Rocky Mountain juniper, skunkbush sumac, and poison ivy. Waterfowl, herons, shorebirds, mink, raccoon, coyote, bobcat, wild turkey, snakes, songbirds, white-tailed deer, mule deer, cottontail rabbit, great horned owl, and small rodents are the most common wildlife species.

The Tassel-Ponderosa-Rock outcrop association makes up the area commonly known as the Pine Ridge. As its name implies, ponderosa pine is common in this area. Other common plants include Rocky Mountain juniper, skunkbush sumac, small soapweed, chokecherry, and blue grama. These plants provide good habitat for woodland wildlife. Wild turkeys, mule deer, porcupine, bobcat, turkey vultures, woodpeckers, fox squirrel, and coyote are typical woodland species in areas of this association. Elk disappeared from this area around the turn of the century. Recently, elk from Wyoming and South Dakota have reestablished themselves in this area.

Engineering

This section provides information for planning land uses related to urban development and to water

management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 14 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope,

and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 15 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 15 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 15 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is

disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 15 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 16 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 16, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil),

the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 17 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to

bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, and sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts and sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 21.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 18 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 19). "Loam," for example, is

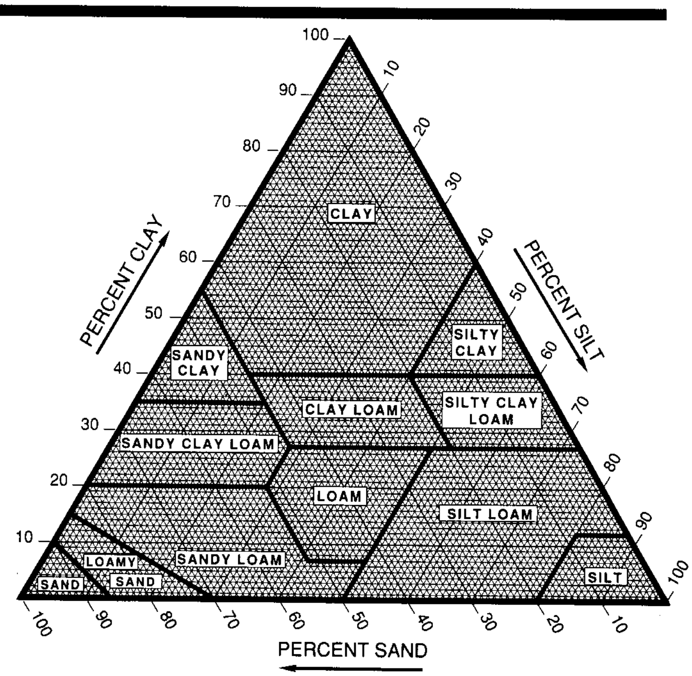


Figure 19.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 21.

Rock fragments 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 19 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For

many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to wind erosion because of rock fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 19, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to

the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 20 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams and by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 20 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information about flooding is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 20 are depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 20.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or

lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 21 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the Nebraska Department of Roads.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 422 (ASTM), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 4318 (ASTM); Plasticity index—T 90 (AASHTO), D 4318 (ASTM); Moisture density—T 99 (AASHTO), D 698 (ASTM); Specific gravity—T 100 (AASHTO), D 854 (ASTM); California bearing ratio—T 193 (AASHTO), D 1883 (ASTM); and Shrinkage—T 92 (AASHTO), D 427 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(4)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 22 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquent (*Aqu*, meaning water, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquents (*Hapl*, meaning minimal horizonation, plus *aquent*, the suborder of the Entisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplaquents.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, nonacid, mesic Typic Haplaquents.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the underlying material can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(6)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(4)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Alliance Series

The Alliance series consists of deep, well drained, moderately permeable soils on uplands. They formed in loess and the underlying calcareous sandstone. Slopes range from 0 to 6 percent.

Alliance soils are commonly adjacent to Canyon, Duroc, Keith, and Rosebud soils. Canyon, Keith, and Rosebud soils are in landscape positions similar to those of the Alliance soils. Canyon soils are shallow to calcareous sandstone. Duroc soils have a mollic epipedon more than 20 inches thick and are lower on the landscape than the Alliance soils. Keith soils do not have calcareous sandstone within a depth of 60 inches. Rosebud soils have sandstone at a depth of 20 to 40 inches.

Typical pedon of Alliance loam, 1 to 3 percent slopes, 800 feet south and 900 feet east of the northwest corner of sec. 29, T. 30 N., R. 46 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; slightly hard, friable; neutral; abrupt smooth boundary.

Bt1—8 to 13 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; very dark brown (10YR 2/2 moist) coatings on ped faces; moderate coarse prismatic structure parting to moderate coarse subangular blocky; hard, firm; neutral; clear smooth boundary.

Bt2—13 to 18 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; very dark grayish brown (10YR 3/2 moist) coatings on ped faces; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; neutral; clear smooth boundary.

BC—18 to 23 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

C—23 to 49 inches; light gray (10YR 7/2) very fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; few fine sandstone fragments; violent effervescence; slightly alkaline; clear smooth boundary.

Cr—49 to 60 inches; white (10YR 8/2), calcareous sandstone, light gray (10YR 7/2) moist; violent effervescence.

The thickness of the solum and the depth to free carbonates range from 16 to 30 inches. The thickness of the mollic epipedon ranges from 8 to 20 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is dominantly loam, but the range includes silt loam. The Bt horizon has value of 5 or 6 (3 to 5 moist) and chroma of 2 or 3. It is dominantly silty clay loam, but the range includes loam, clay loam, and silt loam. The Bt horizon ranges from 25 to 35 percent clay. The C horizon has value of 6 to 8 (5 or 6 moist) and chroma of 2 or 3. It is typically very fine sandy loam, but the range includes loam, fine sandy loam, and silt loam. Fine-grained sandstone is at a depth of 40 to 60 inches.

Almeria Series

The Almeria series consists of very deep, very poorly drained, rapidly permeable soils on bottom land. These soils formed in sandy alluvium. Slopes range from 0 to 2 percent.

Almeria soils are commonly adjacent to Bolent and Calamus soils. Bolent soils are somewhat poorly drained, and Calamus soils are moderately well drained. The adjacent soils are higher on the landscape than the Almeria soils.

Typical pedon of Almeria loamy fine sand, channeled, 0 to 2 percent slopes, 800 feet north and 1,250 feet east of the southwest corner of sec. 28, T. 30 N., R. 44 W.

A—0 to 8 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; few medium distinct dark yellowish brown (10YR 4/4 moist) mottles; weak medium granular structure; soft, very friable; common thin dark strata of loam; slight effervescence; moderately alkaline; clear smooth boundary.

C1—8 to 18 inches; light gray (10YR 7/2) sand, light brownish gray (10YR 6/2) moist; common fine distinct yellowish brown (10YR 5/4 moist) mottles; single grain; loose; slight effervescence; moderately alkaline; gradual smooth boundary.

C2—18 to 60 inches; light gray (10YR 7/2) stratified sand and loamy very fine sand, light brownish gray (10YR 6/2) moist; single grain; loose; 12 percent gravel, by volume; slight effervescence; moderately alkaline.

The depth to free carbonates ranges from 0 to 15 inches.

The A horizon has value of 3 to 6 (2 to 5 moist) and chroma of 1 to 3. It is dominantly loamy fine sand, but the range includes fine sandy loam and fine sand. The C horizon has value of 3 to 8 (2 to 7 moist) and chroma of 1 to 3. It is dominantly sand or fine sand stratified with finer and coarser textured material. The content of gravel in the C horizon is 2 to 15 percent, by volume.

Bankard Series

The Bankard series consists of very deep, somewhat excessively drained, rapidly permeable soils on bottom land. These soils formed in stratified, sandy alluvium (fig. 20). Slopes range from 0 to 2 percent.

Bankard soils are commonly adjacent to Bridget and Satanta soils. The adjacent soils are higher on the landscape than the Bankard soils. They have less sand and more silt in the control section and are not stratified.

Typical pedon of Bankard loamy fine sand, channeled, 0 to 2 percent slopes, 100 feet south and 1,000 feet west of the northeast corner of sec. 8, T. 30 N., R. 46 W.

A—0 to 7 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak moderate subangular blocky structure; soft, very friable; thin strata of fine sandy loam; slightly alkaline; clear wavy boundary.

C1—7 to 30 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; single grain; loose; thin strata of gravelly coarse sand; slight effervescence; moderately alkaline; gradual wavy boundary.

C2—30 to 60 inches; light gray (10YR 7/2) loamy very fine sand, light brownish gray (10YR 6/2) moist; single grain; loose; thin strata of gravelly coarse sand; slight effervescence; moderately alkaline.

The depth to free carbonates is less than 10 inches.

The A horizon has value of 5 or 6 (3 to 5 moist) and chroma of 2 to 4. It is dominantly loamy fine sand, but the range includes fine sandy loam. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4. It is sand, fine sand, loamy sand, loamy fine sand, and loamy very fine sand. Strata of finer and coarser textured material are throughout the profile.

Beckton Series

The Beckton series consists of very deep, moderately well drained, slowly permeable soils on alluvial fans and low stream terraces. These soils formed in loamy alluvium. Slopes range from 0 to 2 percent.

Beckton soils are commonly adjacent to Lute soils, which are somewhat poorly drained and are slightly lower on the landscape than the Beckton soils.

Typical pedon of Beckton silt loam, 0 to 2 percent slopes, 450 feet west and 600 feet south of the northeast corner of sec. 31, T. 33 N., R. 45 W.

A—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; neutral; abrupt wavy boundary.

E—5 to 8 inches; light gray (10YR 6/1) silt loam, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to weak fine subangular blocky; soft, very friable; neutral; abrupt wavy boundary.

Btn—8 to 18 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium columnar structure parting to moderate fine subangular blocky; slightly hard, firm; common thin clay films on faces of peds; 29 percent exchangeable sodium; slightly alkaline; clear wavy boundary.

BCn—18 to 35 inches; brown (10YR 5/3) silt loam, dark grayish brown (10YR 4/2) moist; moderate coarse prismatic structure parting to moderate fine subangular blocky; soft, very friable; 47 percent exchangeable sodium; threads of finely crystalline gypsum; violent effervescence; strongly alkaline; gradual wavy boundary.

Cn—35 to 50 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable; violent effervescence; 58 percent exchangeable sodium; very strongly alkaline; gradual wavy boundary.

C—50 to 60 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable; violent effervescence; 26 percent exchangeable sodium; very strongly alkaline.

The thickness of the solum ranges from 22 to 40 inches, and the depth to free carbonates ranges from 10 to 24 inches. The percentage of exchangeable sodium is more than 15 throughout the solum.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is dominantly silt loam, but the range includes fine sandy loam and loam. The E horizon, if it occurs, has value of 5 or 6 (3 to 5 moist). It is dominantly silt loam, but the range includes loam and fine sandy loam. The Btn horizon has value of 4 to 6 (3 to 5 moist) and chroma of 2 or 3. It is dominantly silty clay loam, but the range includes clay loam and silty clay in which the content of clay ranges from 35 to 45 percent. The C horizon has hue of 2.5Y or 10YR, value of 5 to 8 (4 to 6 moist), and chroma of 2 or 3. It is dominantly silt loam, but the range includes loam, silty clay loam, clay loam, sandy clay loam, and silty clay.

Bolent Series

The Bolent series consists of very deep, somewhat poorly drained, rapidly permeable soils on bottom land along the Niobrara River and its tributaries. These soils formed in recent sandy alluvium. Slopes range from 0 to 2 percent.

Bolent soils are commonly adjacent to Almeria, Calamus, and Las Animas soils. Almeria soils are very

poorly drained and are slightly lower on the landscape than the Bolent soils. Calamus soils are moderately well drained and are higher on the landscape than the Bolent soils. Las Animas soils contain more silt and clay in the control section than the Bolent soils and are in similar landscape positions.

Typical pedon of Bolent loamy fine sand, 0 to 2 percent slopes, 2,400 feet south and 1,500 feet west of the northeast corner of sec. 22, T. 30 N., R. 44 W.

A—0 to 7 inches; light brownish gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; 2 percent gravel, by volume; violent effervescence; moderately alkaline; abrupt smooth boundary.

C1—7 to 19 inches; light gray (10YR 7/2) fine sand stratified with thin layers of grayish brown (10YR 5/2) loamy fine sand, grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2) moist; single grain; loose; 2 percent gravel, by volume; violent effervescence; moderately alkaline; clear smooth boundary.

C2—19 to 26 inches; stratified white (10YR 8/2) and light gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) and grayish brown (10YR 5/2) moist; common medium distinct yellowish brown (10YR 5/6 moist) mottles; single grain; loose; violent effervescence; moderately alkaline; clear smooth boundary.

C3—26 to 57 inches; white (10YR 8/2) fine sand stratified with layers of light gray (10YR 7/2) loamy very fine sand, light brownish gray (10YR 6/2) and grayish brown (10YR 5/2) moist; common medium distinct yellowish brown (10YR 5/2 moist) mottles; single grain; loose; slightly alkaline; abrupt smooth boundary.

C4—57 to 60 inches; white (10YR 8/1) fine sand, light gray (10YR 6/1) moist; single grain; loose; slightly alkaline.

Some pedons contain as much as 5 percent gravel, by volume.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 1 or 2. It is dominantly loamy fine sand, but the range includes fine sandy loam and fine sand. Some pedons have an AC horizon. The C horizon has hue of 10YR or 2.5Y, value of 6 to 8 (5 to 7 moist), and chroma of 1 to 3. It is dominantly fine sand, but the range includes loamy fine sand, loamy sand, and sand. The C horizon has brownish or reddish mottles and is typically stratified with lenses of lighter and darker material that is finer textured.

Bridget Series

The Bridget series consists of very deep, well drained, moderately permeable soils on foot slopes, stream terraces, and alluvial fans. These soils formed in loamy colluvial and alluvial sediments. Slopes range from 0 to 3 percent.

Bridget soils are commonly adjacent to Duroc, Oglala, Ponderosa, and Thirtynine soils. Duroc soils have a mollic epipedon that is more than 20 inches thick. They are slightly lower on the landscape than the Bridget soils. Oglala soils have soft, calcareous sandstone below a depth of 40 inches and are higher on the landscape than the Bridget soils. Ponderosa soils are coarse-loamy and are higher on the landscape than the Bridget soils. Thirtynine soils have an argillic horizon and are higher on the landscape than the Bridget soils.

Typical pedon of Bridget loam, 0 to 1 percent slopes, 2,450 feet north and 750 feet west of the southeast corner of sec. 6, T. 30 N., R. 46 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

A—6 to 9 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak fine subangular blocky; slightly hard, very friable; neutral; gradual smooth boundary.

AC—9 to 15 inches; light brownish gray (10YR 6/2) loam, brown (10YR 4/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable; strong effervescence; slightly alkaline; gradual smooth boundary.

C1—15 to 48 inches; light gray (10YR 7/2) loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure parting to weak fine subangular blocky; soft, very friable; violent effervescence; moderately alkaline; gradual smooth boundary.

C2—48 to 60 inches; light gray (10YR 7/2) loam, brown (10YR 5/3) moist; massive; soft, very friable; violent effervescence; moderately alkaline.

The depth to free carbonates ranges from 0 to 15 inches. The thickness of the mollic epipedon ranges from 7 to 20 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is dominantly loam or very fine sandy loam, but the range includes silt loam. The C horizon has value of 6 to 8 (4 to 6 moist) and chroma

of 2 or 3. It is dominantly loam, but the range includes silt loam and very fine sandy loam.

Bufton Series

The Bufton series consists of very deep, well drained, moderately slowly permeable soils on uplands, foot slopes, and stream terraces. They formed in residuum weathered from silty shale or in colluvial and alluvial sediments weathered from shale. Slopes range from 0 to 20 percent.

Bufton soils are commonly adjacent to Enning, Mitchell, Orella, and Thirtynine soils. The adjacent soils are on landscape positions similar to those of the Bufton soils. Enning and Orella soils are shallow to bedrock. Mitchell and Thirtynine soils formed in material weathered from siltstone. Mitchell soils have less clay in the control section than the Bufton soils. Thirtynine soils have a mollic epipedon.

Typical pedon of Bufton silty clay loam, in an area of Bufton-Orella complex, 3 to 9 percent slopes; 300 feet east and 2,550 feet south of the northwest corner of sec. 16, T. 34 N., R. 46 W.

A—0 to 5 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure parting to moderate fine and medium granular; slightly hard, friable; neutral; clear wavy boundary.

Bw1—5 to 10 inches; light brownish gray (10YR 6/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to moderate fine blocky; hard, firm; strong effervescence; moderately alkaline; clear wavy boundary.

Bw2—10 to 18 inches; light gray (10YR 7/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to moderate medium blocky; hard, firm; strong effervescence; moderately alkaline; clear wavy boundary.

Bk—18 to 23 inches; light gray (2.5Y 7/2) silty clay loam, grayish brown (2.5Y 5/2) moist; weak coarse prismatic structure parting to weak medium blocky; hard, firm; few threadlike accumulations of carbonates; violent effervescence; moderately alkaline; clear wavy boundary.

C—23 to 60 inches; light gray (2.5Y 7/2) silty clay loam, light brownish gray (2.5Y 6/2) moist; massive; slightly hard, friable; 3 percent, by volume, shale channers; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 13 to 41 inches, and the depth to free carbonates ranges from 0 to 6 inches. Chalcedony fragments are commonly on the surface and throughout the profile.

The A horizon has value of 4 to 6 (3 or 4 moist). Horizons that have value of less than 3.5 moist are less than 7 inches thick. The A horizon is dominantly silty clay loam, but the range includes clay loam or silt loam. The Bw horizon has value of 5 to 8 (4 to 7 moist) and chroma of 2 to 4. It is silty clay loam, silty clay, or clay loam in which the content of clay ranges from 35 to 45 percent. The Bk horizon has hue of 2.5Y or 10YR, value of 6 to 8 (5 to 7 moist), and chroma of 2 to 4. It is silty clay loam, clay loam, or silty clay. The C horizon has colors similar to those of the Bk horizon. It is dominantly silty clay loam, but the range includes silt loam to silty clay. Silty shale is below a depth of 60 inches.

Busher Series

The Busher series consists of deep, well drained, moderately rapidly permeable soils on uplands. These soils formed in material weathered from calcareous sandstone. Slopes range from 0 to 30 percent.

Busher soils are commonly adjacent to Jayem, Oglala, Satanta, Tassel, and Tuthill soils. The adjacent soils are in landscape positions similar to those of the Busher soils. Jayem soils do not have sandstone within a depth of 60 inches. Oglala soils are coarse-silty. Satanta and Tuthill soils have more clay in the control section than the Busher soils and have bedrock below a depth of 60 inches. Tassel soils have calcareous sandstone within a depth of 20 inches.

Typical pedon of Busher fine sandy loam, in an area of Busher-Tassel complex, 6 to 30 percent slopes; 1,900 feet north and 300 feet west of the southeast corner of sec. 31, T. 27 N., R. 46 W.

A1—0 to 5 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slightly alkaline; clear smooth boundary.

A2—5 to 10 inches; dark brown (10YR 4/3) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; soft, very friable; slightly alkaline; clear smooth boundary.

Bw—10 to 18 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to weak medium and coarse subangular blocky; soft, very friable; slightly alkaline; clear smooth boundary.

C1—18 to 30 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; massive;

soft, very friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

C2—30 to 44 inches; white (10YR 8/2) loamy very fine sand, light brownish gray (10YR 6/2) moist; single grain; loose; violent effervescence; moderately alkaline; clear smooth boundary.

Cr—44 to 60 inches; white (10YR 8/2), calcareous sandstone, light gray (10YR 7/2) moist; violent effervescence.

The thickness of the solum ranges from 15 to 40 inches, and the depth to free carbonates ranges from 15 to 36 inches. The thickness of the mollic epipedon ranges from 7 to 20 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is dominantly fine sandy loam, but the range includes loamy very fine sand and very fine sandy loam. The Bw horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3. It is dominantly fine sandy loam, but the range includes very fine sandy loam and loamy very fine sand. The C horizon has value of 5 to 8 (4 to 7 moist) and chroma of 2 or 3. It is dominantly fine sandy loam and loamy very fine sand, but the range includes very fine sandy loam. Calcareous sandstone is at a depth of 40 to 60 inches.

Calamus Series

The Calamus series consists of very deep, moderately well drained, rapidly permeable soils on bottom land along the Niobrara River and its tributaries. These soils formed in sandy alluvium. Slopes range from 0 to 2 percent.

Calamus soils are commonly adjacent to Almeria, Bolent, Las Animas, and Munjor soils. Almeria soils are very poorly drained and are lower on the landscape than the Calamus soils. Bolent and Las Animas soils are somewhat poorly drained and are lower on the landscape than the Calamus soils. Munjor soils are well drained, are coarse-loamy in the control section, and are in landscape positions similar to those of the Calamus soils.

Typical pedon of Calamus loamy fine sand, 0 to 2 percent slopes, 2,500 feet north and 1,100 feet west of the southeast corner of sec. 28, T. 30 N., R. 44 W.

A—0 to 9 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak medium granular structure; soft, very friable; neutral; clear smooth boundary.

AC—9 to 18 inches; light brownish gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; loose; neutral; gradual smooth boundary.

C1—18 to 37 inches; light gray (10YR 7/2) fine sand, grayish brown (10YR 5/2) moist; single grain; loose; slightly alkaline; clear smooth boundary.

C2—37 to 60 inches; light gray (10YR 7/2) fine sand, grayish brown (10YR 5/2) moist; strong medium distinct yellowish brown (10YR 5/6) mottles; single grain; loose; thin strata of fine sandy loam and loamy fine sand; slightly alkaline.

Typically, this soil does not have free carbonates. The depth to mottles is 20 to 40 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is dominantly loamy fine sand, but the range includes loamy sand and fine sand. The C horizon has value of 6 to 8 (5 to 7 moist) and chroma of 2 or 3. It is dominantly fine sand, but the range includes loamy sand to coarse sand. Strata of coarser textured material are common in the C horizon. The content of gravel is as much as 15 percent, by volume.

Canyon Series

The Canyon series consists of shallow, well drained, moderately permeable soils on uplands. These soils formed in loamy material weathered from calcareous sandstone. Slopes range from 3 to 30 percent.

Canyon soils are commonly adjacent to Alliance, Oglala, Rosebud, and Satanta soils. The adjacent soils have a mollic epipedon and are more than 20 inches deep to calcareous sandstone. Satanta soils do not have sandstone within a depth of 60 inches. These soils are lower on the landscape than the Canyon soils.

Typical pedon of Canyon loam, in an area of Oglala-Canyon complex, 11 to 30 percent slopes, 1,100 feet east and 350 feet south of the northwest corner of sec. 12, T. 32 N., R. 44 W.

A—0 to 5 inches; grayish brown (10YR 5/2) loam, very dark brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; slightly alkaline; clear smooth boundary.

AC—5 to 10 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; 2 percent, by volume, sandstone pebbles; violent effervescence; moderately alkaline; clear wavy boundary.

C—10 to 14 inches; light gray (10YR 7/2) very fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; 10 percent, by volume, sandstone pebbles; violent effervescence; moderately alkaline; clear wavy boundary.

Cr—14 to 60 inches; white (10YR 8/2), calcareous sandstone, light gray (10YR 7/2) moist; violent effervescence.

The depth to free carbonates ranges from 0 to 6 inches. The depth to bedrock ranges from 6 to 20 inches. The content of clay in the control section ranges from 12 to 25 percent.

The A horizon has value of 4 to 6 (3 to 5 moist) and chroma of 2 or 3. It is dominantly loam, but the range includes fine sandy loam and very fine sandy loam. The AC horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3. It is dominantly very fine sandy loam, but the range includes loam and fine sandy loam. The C horizon has value of 6 to 8 (4 to 7 moist) and chroma of 2 or 3. It is dominantly very fine sandy loam, but the range includes loam and gravelly loam.

Crowther Series

The Crowther series consists of very deep, poorly drained and very poorly drained soils in sandhill valleys. Permeability is moderate in the solum and rapid in the underlying material. These soils formed in calcareous loamy and sandy alluvium. Slopes range from 0 to 1 percent.

Crowther soils are commonly adjacent to Els, Hoffland, Ipage, Marlake, and Wildhorse soils. Els, Ipage, and Wildhorse soils are slightly higher on the landscape than the Crowther soils and have a sandy control section. Els and Wildhorse soils are somewhat poorly drained. Ipage soils are moderately well drained. Hoffland soils have a sandy control section and are in landscape positions similar to those of the Crowther soils. Marlake soils have a sandy control section and are lower on the landscape than the Crowther soils. They have water on the surface for most of the growing season.

Typical pedon of Crowther loam, 0 to 1 percent slopes, 2,400 feet south and 1,900 feet east of the northwest corner of sec. 10, T. 24 N., R. 44 W.

O—1 inch to 0; partly decomposed grass litter; violent effervescence.

Ak1—0 to 3 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; weak fine granular structure; soft, very friable; 25 percent calcium carbonates; violent effervescence; moderately alkaline; abrupt smooth boundary.

Ak2—3 to 6 inches; light gray (10YR 6/1) and gray (10YR 5/1), crushed clay loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, friable; 31 percent calcium carbonates; violent effervescence; moderately alkaline; clear smooth boundary.

Ak3—6 to 8 inches; light gray (10YR 6/1) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable; 39 percent calcium carbonates; violent effervescence; moderately alkaline; clear smooth boundary.

Ak4—8 to 18 inches; light gray (10YR 6/1) loam, very dark gray (10YR 3/1) moist; few fine faint dark yellowish brown (10YR 4/4 moist) mottles; weak coarse subangular blocky structure parting to weak fine granular; slightly hard, friable; 33 percent calcium carbonates; violent effervescence; moderately alkaline; clear smooth boundary.

ACk—18 to 28 inches; light gray (10YR 7/1) sandy clay loam, dark grayish brown (10YR 4/2) moist; few fine faint dark yellowish brown (10YR 4/4 moist) mottles; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; 25 percent calcium carbonates; violent effervescence; moderately alkaline; clear wavy boundary.

2C1—28 to 40 inches; light gray (2.5Y 7/2) fine sand, light brownish gray (2.5Y 6/2) moist; common medium prominent dark yellowish brown (10YR 4/4 moist) mottles; single grain; loose; slightly alkaline; clear wavy boundary.

2C2—40 to 60 inches; light gray (2.5Y 7/2) fine sand, light brownish gray (2.5Y 6/2) moist; common medium distinct dark yellowish brown (10YR 3/4 moist) and yellowish brown (10YR 5/6 moist) mottles; single grain; loose; slightly alkaline.

The thickness of the solum ranges from 20 to 35 inches, and the thickness of the mollic epipedon ranges from 7 to 20 inches. Free carbonates are at the surface and throughout the solum. The content of calcium carbonate ranges from 15 to 40 percent throughout the solum.

The Ak horizon has value of 4 to 6 (2 or 3 moist) and chroma of 1 or 2. It is dominantly loam and clay loam, but the range includes silt loam and fine sandy loam. The 2C horizon has hue of 10YR to 5Y, value of 5 to 8 (4 to 6 moist), and chroma of 1 or 2. It is dominantly fine sand, but the range includes loamy fine sand, loamy sand, and sand.

Dailey Series

The Dailey series consists of very deep, somewhat excessively drained, rapidly permeable soils on uplands and in sandhill valleys. These soils formed in eolian sand. Slopes range from 0 to 9 percent.

Dailey soils are commonly adjacent to Els, Ipage, Jayem, Tuthill, and Valent soils. Els soils are somewhat

poorly drained and do not have a mollic epipedon. Ipage soils are moderately well drained, do not have a mollic epipedon, and are lower on the landscape than the Dailey soils. Jayem and Tuthill soils contain more clay in the subsoil than the Dailey soils, are well drained, and are in similar landscape positions. Valent soils do not have a mollic epipedon and are higher on the landscape than the Dailey soils.

Typical pedon of Dailey loamy fine sand, 0 to 3 percent slopes, 250 feet west and 2,150 feet south of the northeast corner of sec. 7, T. 26 N., R. 41 W.

A1—0 to 9 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; soft, very friable; neutral; abrupt smooth boundary.

A2—9 to 15 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; soft, very friable; neutral; clear smooth boundary.

AC—15 to 26 inches; pale brown (10YR 6/3) fine sand, dark brown (10YR 4/3) moist; weak medium prismatic structure; soft, very friable; neutral; clear smooth boundary.

C1—26 to 42 inches; light yellowish brown (10YR 6/4) fine sand, brown (10YR 5/3) moist; single grain; loose; neutral; clear wavy boundary.

C2—42 to 60 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; single grain; loose; slightly alkaline.

The thickness of the mollic epipedon ranges from 10 to 20 inches. In some pedons carbonates are below a depth of 40 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is dominantly loamy fine sand, but the range includes loamy sand and fine sand. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4. It is dominantly fine sand, but the range includes loamy fine sand or loamy sand.

Duroc Series

The Duroc series consists of very deep, well drained, moderately permeable soils on toe slopes and in swales on uplands. These soils formed in local loamy alluvial and colluvial sediments and loess. Slopes range from 0 to 3 percent.

Duroc soils are commonly adjacent to Alliance, Bridget, Keith, and Rosebud soils. Alliance, Keith, and Rosebud soils have an argillic horizon, have a mollic epipedon less than 20 inches thick, and are higher on the landscape than the Duroc soils. Bridget soils have less clay in the control section than the Duroc soils and are higher on the landscape.

Typical pedon of Duroc loam, 1 to 3 percent slopes, 500 feet south and 500 feet east of the northwest corner of sec. 35, T. 32 N., R. 45 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; soft, very friable; neutral; abrupt smooth boundary.

A1—6 to 24 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

A2—24 to 32 inches; light brownish gray (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to moderate fine subangular blocky; slightly hard, friable; slightly alkaline; clear smooth boundary.

C—32 to 60 inches; light gray (10YR 7/2) loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, friable; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 20 to 50 inches. The depth to free carbonates ranges from 10 to 36 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is dominantly loam, but the range includes silt loam. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3. It is dominantly loam, but the range includes silt loam and very fine sandy loam.

Els Series

The Els series consists of very deep, somewhat poorly drained, rapidly permeable soils in sandhill valleys. They formed in eolian sand and sandy alluvium. Slopes range from 0 to 2 percent.

Els soils are commonly adjacent to Crowther, Hoffland, Ipage, Tryon, Valentine, and Wildhorse soils. Crowther, Hoffland, and Tryon soils are poorly drained and very poorly drained and are lower on the landscape than the Els soils. Ipage and Valentine soils are better drained than the Els soils and are higher on the landscape. Wildhorse soils are very strongly alkaline and are in landscape positions similar to those of the Els soils.

Typical pedon of Els fine sand, calcareous, 0 to 2 percent slopes, 1,650 feet west and 1,500 feet north of the southeast corner of sec. 31, T. 26 N., R. 41 W.

A—0 to 7 inches; gray (10YR 5/1) fine sand, very dark

grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slight effervescence; moderately alkaline; clear wavy boundary.

AC—7 to 13 inches; grayish brown (10YR 5/2) fine sand, dark grayish brown (10YR 4/2) moist; few medium faint dark brown (10YR 3/3 moist) mottles; weak medium subangular blocky structure parting to weak fine granular; soft, very friable; slight effervescence; moderately alkaline; clear wavy boundary.

C—13 to 60 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; common medium distinct yellowish brown (10YR 5/6 moist) mottles; single grain; loose; slight effervescence; slightly alkaline.

The depth to free carbonates ranges from 0 to 15 inches.

The A horizon has value of 4 or 5 (3 moist) and chroma of 1 or 2. It is dominantly fine sand, but the range includes loamy fine sand. The C horizon has hue of 10YR or 2.5Y, value of 5 to 8 (4 to 7 moist), and chroma of 2 or 3. It is fine sand, sand, or loamy sand. In some pedons the C horizon has thin, dark layers of loamy fine sand or fine sand.

Elsmere Series

The Elsmere series consists of very deep, somewhat poorly drained, rapidly permeable soils in sandhill valleys. They formed in eolian sand and sandy alluvium. Slopes range from 0 to 2 percent.

Elsmere soils are commonly adjacent to Dailey, Els, Ipage, Tryon, Valent, and Valentine soils. Dailey, Ipage, Valent, and Valentine soils are better drained than the Elsmere soils and are higher on the landscape. Els soils do not have a mollic epipedon and are in landscape positions similar to those of the Elsmere soils. Ipage, Valent, and Valentine soils also do not have a mollic epipedon. Tryon soils do not have a mollic epipedon, are poorly drained and very poorly drained, and are lower on the landscape than the Elsmere soils.

Typical pedon of Elsmere loamy fine sand, 0 to 2 percent slopes, 1,150 feet west and 500 feet north of the southeast corner of sec. 9, T. 27 N., R. 43 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slightly alkaline; abrupt smooth boundary.

A—6 to 11 inches; very dark grayish brown (10YR 3/2) loamy fine sand, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to weak fine granular; soft, very friable; slightly alkaline; clear smooth boundary.

AC—11 to 17 inches; grayish brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak fine granular; soft, very friable; slightly alkaline; clear smooth boundary.

C1—17 to 35 inches; light brownish gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; few fine distinct yellowish brown (10YR 5/4 moist) mottles; single grain; loose; slightly alkaline; clear wavy boundary.

C2—35 to 60 inches; light gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; few medium distinct yellowish brown (10YR 5/4 moist) mottles; single grain; loose; slightly alkaline.

The thickness of the mollic epipedon ranges from 10 to 20 inches. Carbonates are not typically in the solum, but some pedons are calcareous in the surface layer.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is dominantly loamy fine sand, but the range includes loamy sand and fine sand. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. It is dominantly fine sand, but the range includes loamy fine sand, loamy sand, and sand.

Enning Series

The Enning series consists of shallow, well drained, moderately permeable soils on uplands. These soils formed in silty, calcareous material weathered from interbedded chalk and shale (fig. 21). Slopes range from 6 to 40 percent.

Enning soils are commonly adjacent to Epping, Manvel, Minnequa, Mitchell, and Thirtynine soils. Epping, Mitchell, and Thirtynine soils formed in material weathered from siltstone and are higher on the landscape than the Enning soils. Minnequa soils have interbedded chalk and shale at a depth of 20 to 40 inches and are lower on the landscape than the Enning soils. Manvel soils are more than 60 inches thick over bedrock and formed in colluvial and alluvial sediments on foot slopes.

Typical pedon of Enning silty clay loam, in an area of Enning-Minnequa complex, 6 to 20 percent slopes; 1,600 feet south and 85 feet west of the northeast corner of sec. 28, T. 35 N., R. 46 W.

A—0 to 3 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium granular structure;

slightly hard, friable; 3 percent calcium carbonates; violent effervescence; moderately alkaline; clear wavy boundary.

AC—3 to 7 inches; light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to moderate fine and medium subangular blocky; hard, friable; 11 percent calcium carbonates; violent effervescence; moderately alkaline; clear wavy boundary.

C—7 to 18 inches; light gray (10YR 7/2) silty clay loam, light brownish gray (10YR 6/2) moist; massive; hard, friable; 32 percent calcium carbonates; 3 percent, by volume, chalk and shale channers; violent effervescence; moderately alkaline; clear wavy boundary.

Cr—18 to 60 inches; white (10YR 8/1), interbedded chalk and shale.

The depth to interbedded chalk and shale ranges from 10 to 20 inches.

The A horizon has value of 5 to 7 (3 or 4 moist) and chroma of 2 to 4. It is dominantly silty clay loam, but the range includes silt loam. The C horizon has hue of 10YR or 2.5Y, value of 6 to 8 (5 to 7 moist), and chroma of 2 to 4. It is dominantly silty clay loam, but the range includes silt loam.

Epping Series

The Epping series consists of shallow, well drained, moderately permeable soils on uplands. These soils formed in loamy sediment weathered from siltstone. Slopes range from 3 to 60 percent.

Epping soils are commonly adjacent to Bridget, Mitchell, and Thirtynine soils. The adjacent soils do not have bedrock within a depth of 60 inches. They are lower on the landscape than the Epping soils. Bridget soils have a mollic epipedon. Thirtynine soils have a mollic epipedon and an argillic horizon.

Typical pedon of Epping very fine sandy loam, in an area of Mitchell-Epping complex, 9 to 30 percent slopes; 950 feet west and 600 feet north of the southeast corner of sec. 34, T. 35 N., R. 45 W.

A—0 to 3 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure parting to weak fine granular; soft, very friable; slightly alkaline; clear wavy boundary.

AC—3 to 6 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak fine and medium subangular blocky; soft, very friable; 5 percent, by volume, small siltstone channers; strong effervescence; slightly alkaline; clear wavy boundary.

C—6 to 15 inches; very pale brown (10YR 7/3) very fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; 10 percent, by volume, small siltstone channers; violent effervescence; moderately alkaline; clear wavy boundary.

Cr—15 to 60 inches; very pale brown (10YR 8/3) siltstone, very pale brown (10YR 7/3) moist; violent effervescence.

The depth to siltstone ranges from 10 to 20 inches. The depth to carbonates ranges from 0 to 6 inches.

The A horizon has value of 5 to 7 (3 or 4 moist) and chroma of 2 or 3. It is dominantly very fine sandy loam, but the range includes silt loam and loam. The C horizon has value of 5 to 7 (4 or 5 moist) and chroma of 2 or 3. It is dominantly very fine sandy loam, but the range includes loam or silt loam.

Gannett Series

The Gannett series consists of very deep, poorly drained and very poorly drained soils in sandhill valleys. Permeability is moderately rapid in the solum and rapid in the underlying material. These soils formed in loamy and sandy alluvium. Slopes range from 0 to 1 percent.

Gannett soils are commonly adjacent to Els, Elsmere, Ipage, Marlake, and Tryon soils. Els and Elsmere soils have more sand in the solum than the Gannett soils, are somewhat poorly drained, and are slightly higher on the landscape. Ipage soils have more sand in the solum than the Gannett soils, are moderately well drained, and are higher on the landscape. Marlake soils have more sand and less silt in the control section than the Gannett soils and are lower on the landscape. They have water on the surface for most of the growing season. Tryon soils do not have a mollic epipedon, have more sand and less silt in the control section than the Gannett soils, and are in similar landscape positions.

Typical pedon of Gannett loam, 0 to 1 percent slopes, 2,100 feet north and 900 feet west of the southeast corner of sec. 20, T. 28 N., R. 41 W.

O—2 inches to 0; partly decomposed organic matter.

A1—0 to 16 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; moderate medium subangular blocky structure parting to moderate fine and medium granular; slightly hard, friable; neutral; clear smooth boundary.

A2—16 to 23 inches; very dark gray (10YR 3/1) loam,

black (10YR 2/1) moist; moderate medium subangular blocky structure; slightly hard, friable; neutral; abrupt smooth boundary.

C—23 to 60 inches; light gray (10YR 7/1) fine sand, gray (10YR 5/1) moist; few medium prominent light yellowish brown (2.5Y 6/4 moist) mottles; single grain; loose; neutral.

The thickness of the solum ranges from 16 to 24 inches. It commonly is the same as the thickness of the mollic epipedon.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly loam, but the range includes fine sandy loam and sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 1 or 2. It is dominantly fine sand, but the range includes loamy sand and sand.

Hoffland Series

The Hoffland series consists of very deep, poorly drained and very poorly drained, rapidly permeable soils in sandhill valleys (fig. 22). These soils formed in sandy alluvium. Slopes range from 0 to 1 percent.

Hoffland soils are commonly adjacent to Crowther, Els, Ipage, Marlake, and Wildhorse soils. Crowther soils are coarse-loamy over sandy or sandy-skeletal and are in landscape positions similar to those of the Hoffland soils. Els and Wildhorse soils are sandy and somewhat poorly drained and are higher on the landscape than the Hoffland soils. Wildhorse soils also are very strongly alkaline. Ipage soils are moderately well drained and are higher on the landscape than the Hoffland soils. Marlake soils are lower on the landscape than the Hoffland soils and have water on the surface for most of the growing season.

Typical pedon of Hoffland fine sandy loam, in an area of Wildhorse-Hoffland complex, 0 to 3 percent slopes; 1,900 feet west and 450 feet north of the southeast corner of sec. 3, T. 24 N., R. 44 W.

O—1 inch to 0; partly decomposed organic matter; strong effervescence.

Ak1—0 to 4 inches; gray (10YR 5/1) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; 23 percent calcium carbonates; violent effervescence; moderately alkaline; clear smooth boundary.

Ak2—4 to 7 inches; gray (10YR 6/1 and 5/1) crushed fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure parting to weak fine granular; soft, very friable; 33 percent calcium carbonates; violent effervescence; moderately alkaline; clear smooth boundary.

Ak3—7 to 11 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure parting to weak very fine granular; slightly hard, very friable; 18 percent calcium carbonates; violent effervescence; moderately alkaline; clear smooth boundary.

C1—11 to 31 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; common fine and medium distinct dark yellowish brown (10YR 4/4 moist) mottles; single grain; loose; moderately alkaline; clear wavy boundary.

C2—31 to 41 inches; light brownish gray (2.5Y 6/2) fine sand, dark grayish brown (2.5Y 4/2) moist; common fine and medium distinct yellowish brown (10YR 5/4 moist) mottles; single grain; loose; slightly alkaline; clear wavy boundary.

C3—41 to 60 inches; light gray (10YR 7/1) fine sand, light brownish gray (10YR 6/2) moist; single grain; loose; stratified with dark grayish brown (2.5Y 4/2) fine sandy loam; slightly alkaline.

The thickness of the solum ranges from 7 to 20 inches. The thickness of the mollic epipedon ranges from 7 to 10 inches. Free carbonates are generally at the surface and throughout the solum.

The upper part of the Ak horizon has value of 4 to 6 (2 or 3 moist) and chroma of 1 or 2. The lower part has value of 4 to 6 (3 or 4 moist) and chroma of 1 or 2. The Ak horizon is dominantly fine sandy loam, but the range includes loam. The C horizon has hue of 10YR or 2.5Y, value of 4 to 8 (2 to 6 moist), and chroma of 1 to 3. It is dominantly fine sand, but the range includes loamy fine sand and sand that has thin strata of fine sandy loam.

Ipage Series

The Ipage series consists of very deep, moderately well drained, rapidly permeable soils in sandhill valleys. These soils formed in eolian sand. Slopes range from 0 to 3 percent.

Ipage soils are commonly adjacent to Crowther, Els, Hoffland, Valent, Valentine, and Wildhorse soils. Crowther and Hoffland soils are poorly drained and very poorly drained and are lower on the landscape than the Ipage soils. Els and Wildhorse soils are somewhat poorly drained and are lower on the landscape than the Ipage soils. Wildhorse soils also are very strongly alkaline. Valent and Valentine soils are excessively drained and are higher on the landscape than the Ipage soils.

Typical pedon of Ipage fine sand, 0 to 3 percent

slopes, 2,100 feet east and 1,600 feet north of the southwest corner of sec. 5, T. 27 N., R. 44 W.

A—0 to 5 inches; dark grayish brown (10YR 4/2) fine sand, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; loose; neutral; clear smooth boundary.

AC—5 to 11 inches; grayish brown (10YR 5/2) fine sand, dark grayish brown (10YR 4/2) moist; single grain; loose; neutral; clear smooth boundary.

C1—11 to 35 inches; light brownish gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; single grain; loose; neutral; clear smooth boundary.

C2—35 to 60 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; few fine distinct yellowish brown (10YR 5/4 moist) mottles; single grain; loose; neutral.

The thickness of the solum ranges from 3 to 18 inches. The depth to free carbonates is typically more than 60 inches but ranges from 20 to 60 inches.

The A horizon has value of 4 to 6 (3 or 4 moist) and chroma of 1 or 2. It is dominantly fine sand, but the range includes sand, loamy sand, and loamy fine sand. The C horizon has value of 6 to 8 (4 to 7 moist) and chroma of 2 or 3. It is dominantly fine sand, but the range includes sand and loamy sand.

Jayem Series

The Jayem series consists of very deep, well drained, moderately rapidly permeable soils on uplands. These soils formed in loamy and sandy eolian material weathered from sandstone (fig. 23). Slopes range from 0 to 9 percent.

Jayem soils are commonly adjacent to Busher, Dailey, Satanta, Tuthill, and Vetal soils. Busher soils have soft, calcareous sandstone at a depth of 40 to 60 inches. Dailey soils have more sand throughout the profile than the Jayem soils. Busher and Dailey soils are in landscape positions similar to those of the Jayem soils. Satanta and Tuthill soils have more clay in the subsoil than the Jayem soils and are in similar landscape positions. Tuthill soils also have fine sand at a depth of 40 to 60 inches. Vetal soils have a mollic epipedon more than 20 inches thick and are lower on the landscape than the Jayem soils.

Typical pedon of Jayem fine sandy loam, 3 to 6 percent slopes, 1,800 feet west and 2,300 feet north of the southeast corner of sec. 3, T. 32 N., R. 41 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; neutral; abrupt smooth boundary.

A—7 to 11 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium granular structure; soft, very friable; neutral; clear wavy boundary.

Bw—11 to 24 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak fine and medium subangular blocky; slightly hard, very friable; slightly alkaline; clear wavy boundary.

C—24 to 60 inches; light gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; slightly alkaline.

The thickness of the solum ranges from 18 to 36 inches. The thickness of the mollic epipedon ranges from 7 to 20 inches. Carbonates are typically below a depth of 40 inches.

The A horizon has hue of 2.5Y or 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is dominantly fine sandy loam, but the range includes loamy fine sand. The Bw horizon has hue of 2.5Y to 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 or 3. It is dominantly fine sandy loam, but the range includes very fine sandy loam. The C horizon has hue of 2.5Y to 7.5YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. It is dominantly fine sandy loam, loamy very fine sand, or very fine sandy loam, but the range includes loamy fine sand, loamy sand, and sand below a depth of 40 inches.

Johnstown Series

The Johnstown series consists of very deep, well drained soils on uplands. Permeability is moderate in the solum and rapid and very rapid in the underlying material. These soils formed in loess and loamy sediment deposited over gravelly sand. Slopes range from 0 to 1 percent.

Johnstown soils are adjacent to Bridget; Keith, gravelly substratum; and Satanta soils. Bridget soils do not have an argillic horizon and are in landscape positions similar to those of the Johnstown soils. Keith, gravelly substratum, soils have a mollic epipedon that is less than 20 inches thick and are in landscape positions similar to those of the Johnstown soils. Satanta soils have more sand in the control section than the Johnstown soils and are higher on the landscape.

Typical pedon of Johnstown loam, 0 to 1 percent slopes, 250 feet west and 1,900 feet south of the northeast corner of sec. 18, T. 29 N., R. 45 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2)

loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

A—7 to 11 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak coarse subangular structure parting to weak medium and fine subangular blocky; slightly hard, friable; neutral; clear smooth boundary.

Bt—11 to 18 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; neutral; clear smooth boundary.

Btb1—18 to 30 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; hard, firm; neutral; clear smooth boundary.

Btb2—30 to 34 inches; pale brown (10YR 6/3) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, firm; slightly alkaline; clear smooth boundary.

BCb—34 to 37 inches; light gray (2.5Y 7/2) loam, grayish brown (2.5Y 5/2) moist; weak medium subangular blocky structure; slightly hard, friable; violent effervescence; moderately alkaline; clear smooth boundary.

C—37 to 43 inches; light gray (2.5Y 7/2) loam, light brownish gray (2.5Y 6/2) moist; massive; soft, very friable; violent effervescence; moderately alkaline; clear smooth boundary.

2C—43 to 60 inches; light gray (10YR 7/2) gravelly coarse sand, pale brown (10YR 6/3) moist; single grain; loose; 29 percent gravel, by volume; strong effervescence; slightly alkaline.

The thickness of the solum ranges from 36 to 55 inches. The depth to carbonates ranges from 30 to more than 60 inches. The thickness of the mollic epipedon ranges from 20 to 44 inches. The depth to the 2C horizon ranges from 40 to 60 inches. The depth to the buried soil ranges from 14 to 36 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 to 3. It is dominantly loam, but the range includes fine sandy loam, silt loam, and clay loam. The Bt horizon has value of 4 or 5 (3 moist) and chroma of 2 or 3. It is dominantly silty clay loam, but the range includes clay loam. The Btb horizon has hue of 10YR or 2.5Y, value of 3 to 6 (2 to 5 moist), and chroma of 1 to 4. It is dominantly silty clay loam, but the range includes clay loam. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is dominantly loam, but the range includes silt loam, very fine sandy loam, or silty clay loam. The 2C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is dominantly gravelly coarse sand, but the range includes coarse sand, sand, fine sand, or loamy sand.

Kadoka Series

The Kadoka series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in silty material weathered from siltstone. Slopes range from 0 to 9 percent.

Kadoka soils are commonly adjacent to Bufton, Epping, Orella, and Thirtynine soils. Bufton and Thirtynine soils are very deep and are in landscape positions similar to those of the Kadoka soils. Epping and Orella soils are shallow over bedrock and are higher on the landscape than the Kadoka soils.

Typical pedon of Kadoka silt loam, 6 to 9 percent slopes, 850 feet east and 1,600 feet south of the northwest corner of sec. 20, T. 35 N., R. 45 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, friable; neutral; abrupt smooth boundary.

Bt—7 to 15 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; weak medium prismatic structure parting to moderate fine subangular blocky; hard, friable; neutral; clear wavy boundary.

Bw—15 to 20 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable; slightly alkaline; clear wavy boundary.

Bk—20 to 27 inches; very pale brown (10YR 8/3) silt loam, very pale brown (10YR 7/3) moist; weak medium subangular blocky structure; slightly hard, friable; secondary calcium carbonates on ped faces; 5 percent, by volume, siltstone channers; violent effervescence; moderately alkaline; gradual wavy boundary.

C—27 to 32 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; massive; 10 percent, by volume, siltstone channers; violent effervescence; moderately alkaline; abrupt wavy boundary.

Cr—32 to 60 inches; very pale brown (10YR 8/4) bedded siltstone; violent effervescence.

The thickness of the solum ranges from 15 to 27 inches. The depth to carbonates ranges from 12 to 25 inches. The thickness of the mollic epipedon ranges from 8 to 16 inches. The depth to bedrock ranges from 20 to 40 inches.

The A horizon has value of 4 or 5 (2 or 3 moist). It is

dominantly silt loam, but the range includes loam or silty clay loam. The Bt horizon has value of 4 to 6 (3 or 4 moist) and chroma of 2 to 4. It is dominantly silty clay loam, but the range includes silt loam and loam. The C horizon has value of 6 to 8 (5 to 7 moist) and chroma of 2 to 4. It is dominantly silt loam, but the range includes loam.

Keith Series

The Keith series consists of very deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slopes range from 0 to 6 percent.

Keith soils are commonly adjacent to Alliance, Bridget, Johnstown, and Satanta soils. Alliance soils have soft, calcareous sandstone at a depth of 40 to 60 inches and are in landscape positions similar to those of the Keith soils. Bridget soils do not have an argillic horizon and are lower on the landscape than the Keith soils. Johnstown soils have a mollic epipedon more than 20 inches thick and are in landscape positions similar to those of the Keith soils. Satanta soils are fine-loamy and are in landscape positions similar to those of the Keith soils.

Typical pedon of Keith loam, 1 to 3 percent slopes, 1,950 feet south and 2,100 feet west of the northeast corner of sec. 18, T. 29 N., R. 46 W.

A—0 to 9 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to weak fine granular; soft, very friable; neutral; clear smooth boundary.

Bt1—9 to 17 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; thin patchy clay films on faces of peds; neutral; gradual smooth boundary.

Bt2—17 to 23 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; thin patchy clay films on faces of peds; clay films on faces of peds; neutral; abrupt smooth boundary.

Bk—23 to 28 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; accumulations of calcium carbonate in cracks and very small concretions; violent effervescence; moderately alkaline; clear smooth boundary.

C1—28 to 45 inches; light gray (10YR 7/2) silt loam, brown (10YR 5/3) moist; massive; soft, very friable; calcium carbonate accumulations; violent effervescence; slightly alkaline; gradual smooth boundary.

C2—45 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; soft, very friable; violent effervescence; slightly alkaline.

The thickness of the solum ranges from 15 to 42 inches. The thickness of the mollic epipedon ranges from 7 to 20 inches. The depth to free carbonates ranges from 15 to 38 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is dominantly loam, but the range includes silt loam and silty clay loam. The Bt horizon has value of 4 to 6 (3 to 5 moist) and chroma of 2 or 3. It is dominantly silty clay loam, but the range includes silt loam, loam, and clay loam. The content of clay in this horizon ranges from 25 to 35 percent. The C horizon has value of 6 to 8 (5 or 6 moist) and chroma of 2 or 3. It is dominantly silt loam, but the range includes loam and very fine sandy loam. A gravelly substratum that has white or pale brown, calcareous gravelly coarse sand, coarse sand, or sand is at a depth of 40 to 60 inches.

Keya Series

The Keya series consists of very deep, well drained, moderately permeable soils in upland swales. These soils formed in local loamy alluvium. Slopes range from 0 to 2 percent.

Keya soils are commonly adjacent to Busher, Jayem, Satanta, Tuthill, and Vetal soils. Busher, Jayem, Satanta, and Tuthill soils have a mollic epipedon less than 20 inches thick and are higher on the landscape than the Keya soils. Busher soils also have soft, calcareous sandstone at a depth of 40 to 60 inches. Busher and Jayem soils are coarse-loamy. Vetal soils are coarse-loamy and are in landscape positions similar to those of the Keya soils.

Typical pedon of Keya loam, 0 to 2 percent slopes, 1,000 feet east and 800 feet north of the southwest corner of sec. 30, T. 31 N., R. 44 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

A—6 to 17 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak moderate fine and medium granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

Bt1—17 to 35 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2)

Figure 20.—Typical profile of Bankard loamy fine sand. The arrows indicate areas of stratification. Depth is marked in feet.

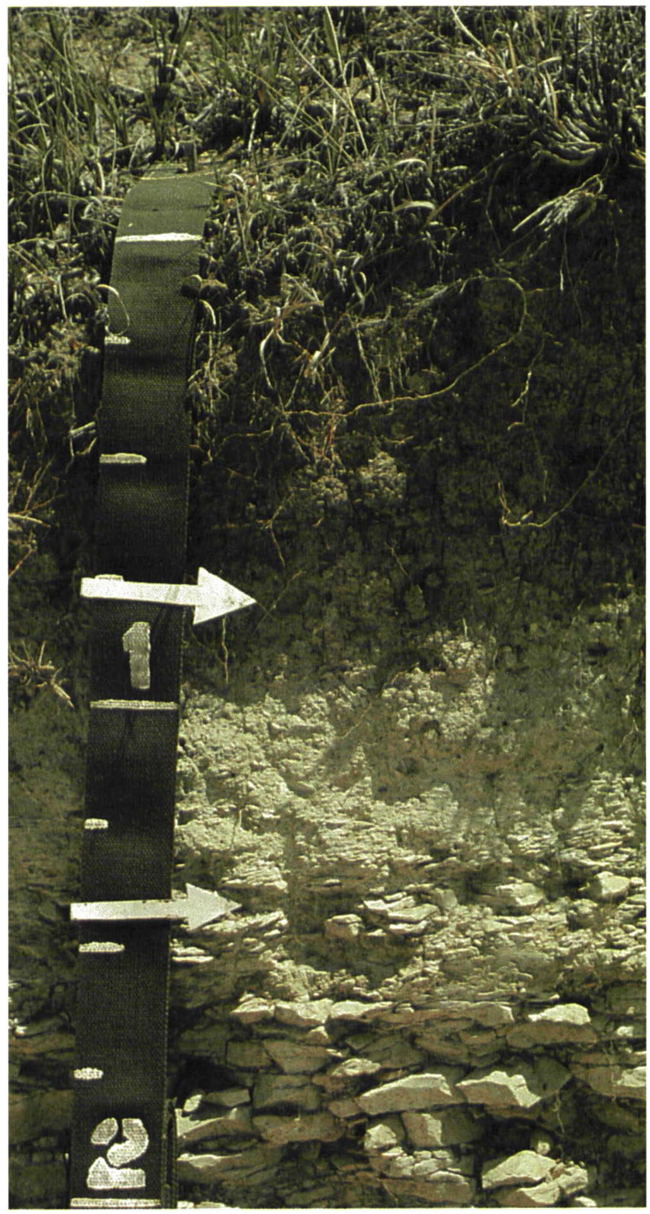


Figure 21.—Typical profile of Enning silty clay loam. The upper arrow indicates the bottom of the surface layer, and the lower arrow indicates the soil contact with the chalky shale. Depth is marked in feet.

Figure 22.—Typical profile of Hoffland fine sandy loam. This poorly drained and very poorly drained, calcareous soil is in sandhill valleys.

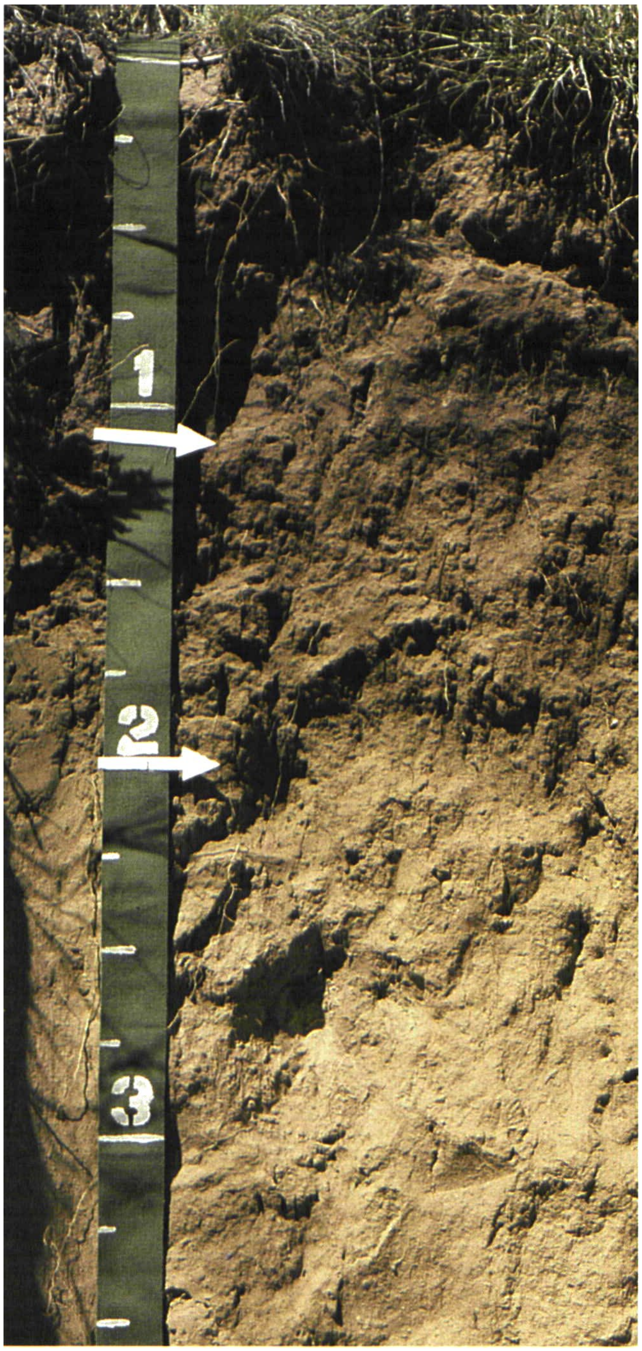


Figure 23.—Typical profile of Jayem fine sandy loam. The upper arrow indicates the lower boundary of the surface soil. The lower arrow indicates the lower boundary of the subsoil. Depth is marked in feet.

Figure 24.—Typical profile of Tuthill fine sandy loam. The upper arrow indicates the lower boundary of the surface soil. The lower arrow indicates the lower boundary of the subsoil. Depth is marked in feet.

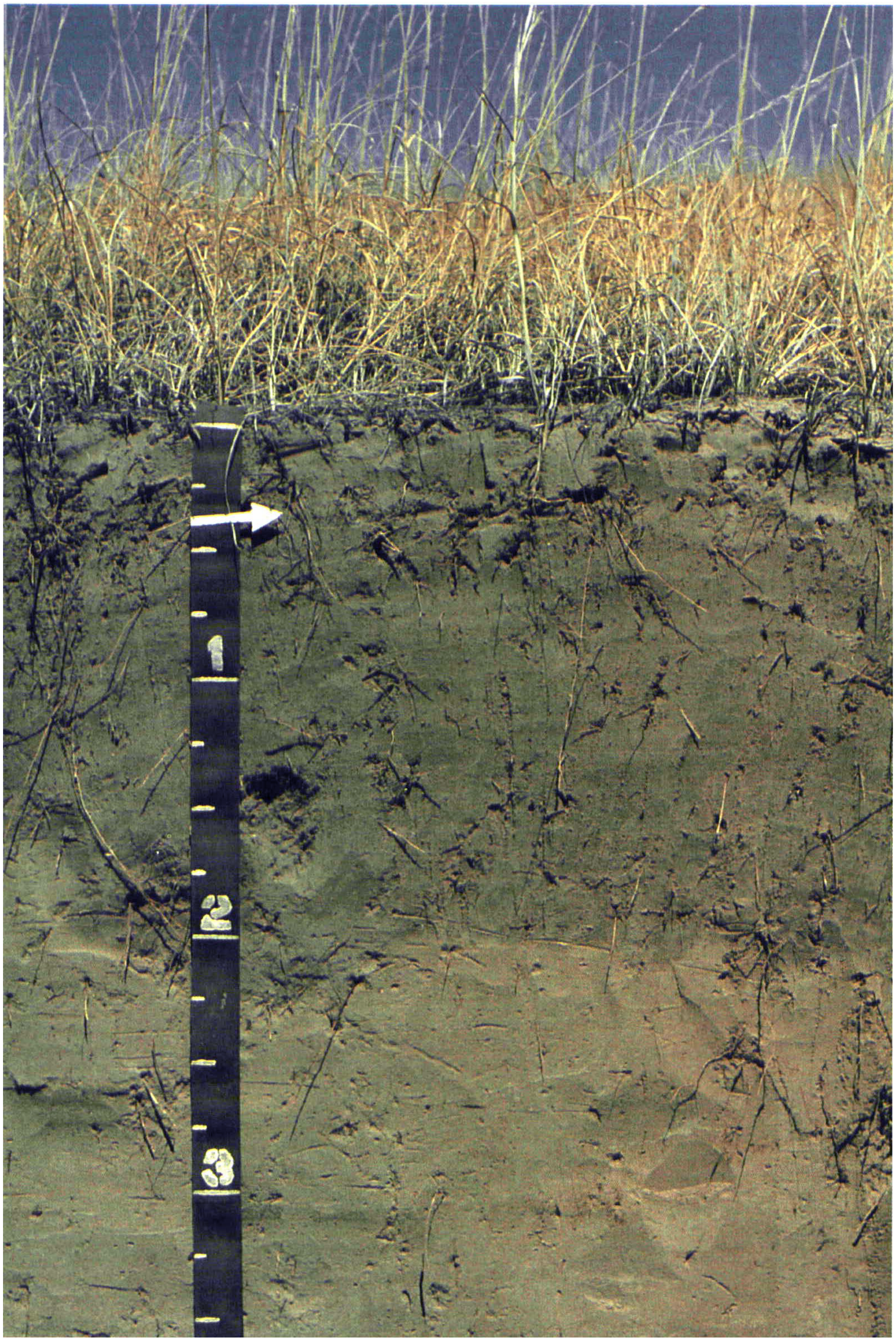


Figure 25.—Typical profile of Valent fine sand. The arrow indicates the lower boundary of the surface soil. Depth is marked in feet.

moist; moderate medium prismatic structure parting to moderate fine subangular blocky; hard, firm; neutral; clear smooth boundary.

Bt2—35 to 40 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; strong coarse prismatic structure parting to strong medium subangular blocky; hard, firm; neutral; clear wavy boundary.

BC—40 to 49 inches; pale brown (10YR 7/3) loam, brown (10YR 5/3) moist; moderate medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable; strong effervescence; moderately alkaline; clear wavy boundary.

C—49 to 60 inches; very pale brown (10YR 7/3) loam, brown (10YR 5/3) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 26 to 58 inches. The thickness of the mollic epipedon ranges from 20 to 45 inches. It extends into the Bt horizon. The depth to free carbonates ranges from 30 to more than 60 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is dominantly loam, but the range includes silt loam. The Bt horizon has value of 4 or 5 (2 to 4 moist) and chroma of 2 or 3. It is dominantly clay loam, but the range includes loam. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3. It is dominantly loam, but the range includes clay loam and fine sandy loam. In some pedons loamy fine sand and fine sand are below a depth of 40 inches.

Las Animas Series

The Las Animas series consists of very deep, somewhat poorly drained, moderately rapidly permeable soils on bottom land. These soils formed in stratified, calcareous loamy and sandy alluvium. Slopes range from 0 to 2 percent.

Las Animas soils are commonly adjacent to Bolent and Calamus soils. The adjacent soils have more sand throughout the profile than the Las Animas soils. Bolent soils are in landscape positions similar to those of the Las Animas soils. Calamus soils are moderately well drained and are higher on the landscape than the Las Animas soils.

Typical pedon of Las Animas loam, 0 to 2 percent slopes, 1,300 feet west and 800 feet north of the southeast corner of sec. 10, T. 30 N., R. 43 W.

A—0 to 5 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; weak medium and coarse granular structure; soft, very friable; slight effervescence; slightly alkaline; abrupt smooth boundary.

Cg1—5 to 27 inches; light gray (2.5Y 7/2) very fine sandy loam, grayish brown (2.5Y 5/2) moist; common medium prominent yellowish brown (10YR 5/4 moist) mottles; massive; soft, very friable; thin strata of loamy very fine sand; strong effervescence; slightly alkaline; clear smooth boundary.

Cg2—27 to 60 inches; light gray (10YR 7/2) fine sand stratified with very fine sandy loam, grayish brown (10YR 5/2) moist; common medium prominent strong brown (7.5YR 5/6 moist) mottles; single grain; loose; strong effervescence; slightly alkaline.

The depth to free carbonates ranges from 0 to 10 inches.

The A horizon has hue of 5Y to 7.5YR, value of 4 to 6 (3 or 4 moist), and chroma of 1 or 2. It is dominantly loam, but the range includes very fine sandy loam and fine sandy loam. The C horizon has hue of 5Y to 7.5YR, value of 5 to 7 (5 or 6 moist), and chroma of 2 or 3. The upper part of the C horizon is dominantly very fine sandy loam, but the range includes loam and fine sandy loam stratified with loamy very fine sand. The lower part is dominantly fine sand that has strata of calcareous loam and very fine sandy loam, but the range includes stratified sand and loamy fine sand.

Lodgepole Series

The Lodgepole series consists of very deep, somewhat poorly drained, very slowly permeable soils in depressions on uplands. These soils formed in loess and loamy sediment. Slopes range from 0 to 1 percent.

Lodgepole soils are commonly adjacent to Alliance, Duroc, Keith, and Satanta soils. The adjacent soils have less clay in the control section than the Lodgepole soils and are higher on the landscape.

Typical pedon of Lodgepole silt loam, 0 to 1 percent slopes, 200 feet west and 2,700 feet south of the northeast corner of sec. 10, T. 31 N., R. 46 W.

A—0 to 5 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

Bt1—5 to 16 inches; dark gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to strong medium subangular blocky; very hard, very firm; thin patchy clay films on faces of peds; neutral; gradual wavy boundary.

Bt2—16 to 32 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; black (10YR 2/1 moist) coatings on peds; few fine faint yellowish brown (10YR 5/4 moist) mottles; moderate medium prismatic structure parting to strong medium subangular blocky; very hard, very firm; thin patchy clay films on faces of peds; neutral; gradual smooth boundary.

BC—32 to 40 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; few fine faint yellowish brown (10YR 5/4 moist) mottles; moderate medium subangular blocky structure; slightly hard, friable; slight effervescence; neutral; clear smooth boundary.

C1—40 to 46 inches; light gray (10YR 7/2) loam, pale brown (10YR 6/3) moist; massive; soft, very friable; strong effervescence; slightly alkaline; clear smooth boundary.

C2—46 to 60 inches; very pale brown (2.5Y 8/2) fine sandy loam, brown (2.5Y 6/4) moist; massive; soft, very friable; strong effervescence; slightly alkaline.

The thickness of the mollic epipedon ranges from 20 to 41 inches, and the depth to free carbonates ranges from 30 to more than 60 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is dominantly silt loam, but the range includes silty clay loam. The Bt horizon has value of 3 to 5 (2 to 4 moist) and chroma of 0 to 2. It is dominantly silty clay, but the range includes clay and silty clay loam. The content of clay ranges from 35 to 40 percent. The C horizon has hue of 2.5Y or 10YR, value of 5 to 8 (4 to 6 moist), and chroma of 2 to 4. It is dominantly loam, but the range includes silt loam or very fine sandy loam. Fine sandy loam, sandy loam, loamy fine sand, or loamy sand is common below a depth of 40 inches.

Lute Series

The Lute series consists of very deep, somewhat poorly drained soils on alluvial fans and low stream terraces. These soils formed in loamy alluvium. Permeability is slow in the subsoil and moderately rapid in the underlying material. Slopes range from 0 to 2 percent.

Lute soils are commonly adjacent to Beckton soils, which are moderately well drained and are slightly higher on the landscape than the Lute soils.

Typical pedon of Lute loam, 0 to 2 percent slopes, 1,000 feet south and 1,000 feet west of the northeast corner of sec. 30, T. 33 N., R. 45 W.

A—0 to 6 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, friable; slightly alkaline; abrupt smooth boundary.

E—6 to 7 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; weak fine granular structure; soft, friable; slightly alkaline; clear wavy boundary.

Btn1—7 to 13 inches; gray (10YR 5/1) sandy clay loam, very dark gray (10YR 3/1) moist; moderate medium columnar structure parting to moderate fine and medium subangular blocky; hard, firm; thin patchy clay films on faces of peds; violent effervescence; moderately alkaline; clear smooth boundary.

Btn2—13 to 18 inches; gray (10YR 5/1) sandy clay loam, dark grayish brown (10YR 4/2) moist; few fine faint dark brown (10YR 4/3 moist) mottles; moderate fine subangular blocky structure; hard, firm; thin patchy clay films on faces of peds; violent effervescence; strongly alkaline; clear wavy boundary.

BCn—18 to 24 inches; grayish brown (10YR 5/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; common medium faint yellowish brown (10YR 5/4 moist) mottles; weak medium subangular blocky structure; soft, very friable; violent effervescence; strongly alkaline; clear wavy boundary.

C—24 to 60 inches; light gray (10YR 7/2) very fine sandy loam stratified with loamy fine sand and loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 10 to 26 inches. The depth to free carbonates ranges from 0 to 10 inches. The percentage of exchangeable sodium is more than 15 in the natric horizon.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is dominantly loam, but the range includes fine sandy loam and loamy fine sand. The E horizon has value of 5 to 7 (3 to 5 moist) and chroma of 1 or 2. It is dominantly loam, but the range includes fine sandy loam and loamy fine sand. The Btn horizon has value of 4 to 6 (3 to 5 moist) and chroma of 1 to 3. It is dominantly sandy clay loam, but the range includes loam and fine sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. It is dominantly very fine sandy loam, but the range includes fine sandy loam and loamy fine sand.

Manvel Series

The Manvel series consists of very deep, well drained, moderately slowly permeable soils on foot

slopes and alluvial fans. These soils formed in calcareous colluvial and alluvial sediments derived from interbedded chalk and shale. Slopes range from 2 to 6 percent.

Manvel soils are commonly adjacent to Bufton, Enning, and Minnequa soils. The adjacent soils are higher on the landscape than the Manvel soils. Bufton soils have more clay than the Manvel soils. Enning soils have chalk and shale at a depth of 10 to 20 inches. Minnequa soils have chalk and shale at a depth of 20 to 40 inches.

Typical pedon of Manvel silty clay loam, 2 to 6 percent slopes, 1,600 feet east and 2,500 feet north of the southwest corner of sec. 26, T. 35 N., R. 46 W.

Ap—0 to 5 inches; light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, friable; 21 percent calcium carbonate; strong effervescence; moderately alkaline; abrupt smooth boundary.

AC—5 to 11 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak fine subangular blocky structure; slightly hard, friable; 2 percent, by volume, chalk and shale channers; 31 percent calcium carbonate; strong effervescence; moderately alkaline; clear smooth boundary.

C1—11 to 50 inches; light gray (2.5Y 7/2) silty clay loam, light olive brown (2.5Y 5/4) moist; massive; hard, firm; 2 percent, by volume, chalk and shale channers; 29 percent calcium carbonate; strong effervescence; moderately alkaline; clear smooth boundary.

C2—50 to 60 inches; pale yellow (2.5Y 7/4) silty clay loam, light olive brown (2.5Y 5/4) moist; massive; hard, firm; 2 percent, by volume, chalk and shale channers; 31 percent calcium carbonate; strong effervescence; moderately alkaline.

Chalk and shale channers range from 0 to 10 percent throughout the profile. Calcium carbonate equivalent ranges from 15 to 40 percent.

The A horizon has hue of 5Y to 7.5YR, value of 5 to 7 (3 to 5 moist), and chroma of 2 to 4. It is dominantly silty clay loam, but the range includes silt loam and loam. The C horizon has hue of 5Y to 7.5YR, value of 6 to 8 (4 or 5 moist), and chroma of 2 to 4. It is dominantly silty clay loam, but the range includes silt loam.

Marlake Series

The Marlake series consists of very deep, very poorly drained, rapidly permeable soils in depressions in sandhill valleys. These soils formed in eolian and alluvial sand. Slopes range from 0 to 1 percent.

Marlake soils are commonly adjacent to Crowther, Els, Gannett, Hoffland, and Tryon soils. Crowther and Gannett soils are coarse-loamy in the upper part of the control section and have a mollic epipedon. These soils are higher on the landscape than the Marlake soils. Els soils are higher on the landscape than the Marlake soils and are somewhat poorly drained. Hoffland and Tryon soils are higher on the landscape than the Marlake soils. Hoffland soils have a calcic horizon. Tryon soils are not stratified in the upper part of the control section.

Typical pedon of Marlake fine sandy loam, 0 to 1 percent slopes, 1,000 feet south and 2,000 feet west of the northeast corner of sec. 3, T. 25 N., R. 44 W.

O—2 inches to 0; partly decomposed plant litter.

A—0 to 7 inches; dark gray (10YR 4/1) fine sandy loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; slight effervescence; slightly alkaline; clear wavy boundary.

AC—7 to 14 inches; grayish brown (10YR 5/2) loamy fine sand stratified with very dark gray (10YR 3/1) fine sandy loam and light brownish gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; weak medium and coarse subangular blocky structure; soft, very friable; strong effervescence; moderately alkaline; clear wavy boundary.

C—14 to 60 inches; light brownish gray (10YR 6/2) loamy fine sand stratified and mixed with gray (10YR 5/1) fine sandy loam and light gray (10YR 7/1) fine sand, grayish brown (2.5Y 5/2) moist; few fine distinct yellowish brown (10YR 5/4 moist) mottles in the upper part; single grain; soft, very friable; strong effervescence; moderately alkaline.

The depth to free carbonates ranges from 0 to 15 inches. The thickness of the mollic colors ranges from 6 to 10 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is dominantly fine sandy loam, but the range includes loamy fine sand. The C horizon has hue of 10YR to 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 1 or 2. It is dominantly loamy fine sand, but the range includes fine sand and sand. Strata of finer textured material are common in the C horizon.

McCook Series

The McCook series consists of very deep, well drained, moderately permeable soils on bottom land. These soils formed in stratified, calcareous, loamy alluvium. Slopes range from 0 to 2 percent.

McCook soils are commonly adjacent to Beckton, Keith, and Munjor soils. Beckton soils have a high content of exchangeable sodium and are moderately well drained. These soils are in landscape positions similar to those of the McCook soils. Keith soils are not stratified and have an argillic horizon. These soils are higher on the landscape than the McCook soils. Munjor soils are coarse-loamy in the control section and are in landscape positions similar to those of the McCook soils.

Typical pedon of McCook loam, 0 to 2 percent slopes, 250 feet east and 2,100 feet south of the northwest corner of sec. 29, T. 34 N., R. 42 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure parting to weak medium granular; slightly hard, friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

A—6 to 12 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak medium granular; slightly hard, friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

AC—12 to 20 inches; stratified light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to weak coarse and medium granular; soft, very friable; strong effervescence; moderately alkaline; clear smooth boundary.

Ab—20 to 33 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium prismatic structure parting to weak fine granular; slightly hard, very friable; strong effervescence; moderately alkaline; clear smooth boundary.

C—33 to 45 inches; pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; weak fine and medium granular structure; soft, very friable; strong effervescence; slightly alkaline; gradual smooth boundary.

Ab —45 to 60 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable; violent effervescence; slightly alkaline.

The thickness of the mollic epipedon ranges from 10 to 20 inches. The depth to free carbonates is dominantly less than 10 inches, and most pedons are calcareous at or near the surface.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is dominantly loam, but the range includes silt loam or fine sandy loam. The AC and C horizons have value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3. It is dominantly loam, but the range includes silt loam or very fine sandy loam. Buried soils and dark loamy strata are common in the C horizon.

Minnequa Series

The Minnequa series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in silty, calcareous material weathered from interbedded chalk and shale. Slopes range from 6 to 20 percent.

Minnequa soils are commonly adjacent to Bufton, Enning, and Manvel soils. Bufton soils contain more clay in the control section than the Minnequa soils and are higher on the landscape. Enning soils have interbedded chalk and shale at a depth of 10 to 20 inches and are higher on the landscape than the Minnequa soils. Manvel soils have 15 to 40 percent calcium carbonate in the control section and are lower on the landscape than the Minnequa soils.

Typical pedon of Minnequa silty clay loam, in an area of Enning-Minnequa complex, 6 to 20 percent slopes; 1,700 feet south and 800 feet west of the northeast corner of sec. 28, T. 35 N., R. 46 W.

A—0 to 4 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak fine and medium granular structure; slightly hard, friable; 12 percent calcium carbonate equivalent; violent effervescence; moderately alkaline; clear wavy boundary.

AC—4 to 10 inches; light brownish gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable; 12 percent calcium carbonate equivalent; violent effervescence; moderately alkaline; clear wavy boundary.

C1—10 to 22 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, friable; 17 percent calcium carbonate equivalent; violent effervescence; moderately alkaline; clear wavy boundary.

C2—22 to 33 inches; light gray (2.5Y 7/2) silt loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, very friable; 25 percent calcium carbonate equivalent; 3 percent, by volume, channers; violent effervescence; moderately alkaline; clear wavy boundary.

Cr—33 to 60 inches; white (2.5Y 8/2), interbedded chalk and shale; violent effervescence.

The depth to free carbonates ranges from 0 to 3 inches. The calcium carbonate equivalent ranges from 10 to 39 percent in the control section.

The A horizon has hue of 5Y to 7.5YR, value of 5 to 8 (3 to 7 moist), and chroma of 1 to 3. It is dominantly silty clay loam, but the range includes silt loam and loam. The C horizon has hue of 5Y to 7.5YR, value of 6 or 7 (5 or 6 moist), and chroma of 2 to 4. It is dominantly silty clay loam and silt loam, but the range includes loam. The depth to the Cr horizon ranges from 20 to 40 inches.

Mitchell Series

The Mitchell series consists of very deep, well drained, moderately permeable soils on uplands. These soils formed in calcareous loamy sediment weathered from siltstone. Slopes range from 9 to 30 percent.

Mitchell soils are commonly adjacent to Bridget, Epping, and Thirtynine soils. Bridget soils have a mollic epipedon and are on foot slopes, alluvial fans, and stream terraces. Epping soils are shallow over siltstone and are higher on the landscape than the Mitchell soils. Thirtynine soils have a mollic epipedon and an argillic horizon. These soils are in landscape positions similar to those of the Mitchell soils.

Typical pedon of Mitchell very fine sandy loam, in an area of Mitchell-Epping complex, 9 to 30 percent slopes; 1,050 feet west and 800 feet north of the southeast corner of sec. 34, T. 35 N., R. 45 W.

A—0 to 4 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium platy structure parting to weak fine granular; soft, very friable; slight effervescence; slightly alkaline; clear wavy boundary.

AC—4 to 9 inches; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 4/3) moist; weak medium prismatic structure parting to weak fine granular; soft, very friable; strong effervescence; moderately alkaline; clear wavy boundary.

C—9 to 60 inches; very pale brown (10YR 7/3) very fine sandy loam, brown (10YR 5/3) moist; massive; 2 percent, by volume, siltstone channers; slightly hard, very friable; violent effervescence; moderately alkaline.

The depth to carbonates ranges from 0 to 10 inches.

The A horizon has value of 5 to 7 (4 or 5 moist) and chroma of 2 or 3. It is dominantly very fine sandy loam, but the range includes loam, silt loam, and fine sandy loam. The C horizon has value of 6 to 8 (5 to 7 moist) and chroma of 2 or 3. It is dominantly very fine sandy loam, but the range includes loam and silt loam.

Munjor Series

The Munjor series consists of very deep, well drained, moderately rapidly permeable soils on bottom land. These soils formed in calcareous, stratified loamy and sandy alluvium. Slopes range from 0 to 2 percent.

Munjor soils are commonly adjacent to Bridget, Oglala, and Ponderosa soils. Bridget and Oglala soils are coarse-silty and are higher on the landscape than the Munjor soils. Ponderosa soils are not stratified and have carbonates below a depth of 15 inches. These soils are higher on the landscape than the Munjor soils.

Typical pedon of Munjor fine sandy loam, 0 to 2 percent slopes, 2,300 feet east and 2,200 feet north of the southwest corner of sec. 16, T. 34 N., R. 44 W.

A—0 to 6 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; soft, very friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

C1—6 to 23 inches; brown (10YR 5/3) loamy very fine sand, dark brown (10YR 4/3) moist; thin strata of pale brown (10YR 6/3) fine sandy loam; massive; soft, very friable; strong effervescence; moderately alkaline; clear smooth boundary.

C2—23 to 60 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; thin strata of very pale brown (10YR 7/3) loamy very fine sand; massive; soft, very friable; slight effervescence in some layers, noncalcareous in others; moderately alkaline.

Typically, these soils are calcareous throughout, but they are leached for a few inches in some pedons.

The A horizon has value of 5 to 7 (3 to 5 moist) and chroma of 2 or 3. It commonly has value darker than 5.5 dry and 3.5 moist but is less than 7 inches thick. It is dominantly fine sandy loam, but the range includes loam, sandy loam, and loamy fine sand. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3. It is dominantly fine sandy loam, but the range includes loam, sandy loam, and loamy very fine sand. In some pedons the C horizon has thin strata of loam, very fine sandy loam, fine sandy loam, loamy fine sand, loamy very fine sand, or fine sand.

Niobrara Series

The Niobrara series consists of shallow, excessively drained, rapidly permeable soils on breaks and canyons of the Niobrara River and its tributaries. These soils formed in sandy material weathered from sandstone. Slopes range from 9 to 30 percent.

Niobrara soils are commonly adjacent to Dailey, Jayem, Orpha, Valent, and Valentine soils. The adjacent soils are very deep. Jayem soils are coarse-loamy. Orpha soils are lower on the landscape than the Niobrara soils. Dailey, Jayem, Valent, and Valentine soils are higher on the landscape than the Niobrara soils.

Typical pedon of Niobrara loamy fine sand, in an area of Orpha-Niobrara complex, 9 to 30 percent slopes; 1,200 feet north and 2,550 feet east of the southwest corner of sec. 33, T. 31 N., R. 43 W.

A—0 to 4 inches; light brownish gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; 2 percent, by volume, sandstone gravel; slight effervescence; slightly alkaline; clear smooth boundary.

C—4 to 13 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; single grain; loose; 5 percent, by volume, sandstone gravel; strong effervescence; moderately alkaline; abrupt wavy boundary.

Cr—13 to 60 inches; white (10YR 9/2), calcareous sandstone, light gray (10YR 7/2) moist; violent effervescence.

The depth to carbonates ranges from 0 to 6 inches. The depth to sandstone ranges from 10 to 20 inches.

The A horizon has value of 4 to 6 (2 to 5 moist) and chroma of 2 or 3. It is dominantly loamy fine sand, but the range includes fine sandy loam and fine sand. Some pedons have an AC horizon. The C horizon has value of 5 to 8 (4 to 6 moist) and chroma of 2 or 3. It is dominantly fine sand, but the range includes loamy fine sand, loamy sand, and sand.

Oglala Series

The Oglala series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loamy material weathered from calcareous sandstone. Slopes range from 3 to 30 percent.

Oglala soils are commonly adjacent to Alliance, Canyon, and Rosebud soils. Alliance soils have more clay in the control section than the Oglala soils and are in similar landscape positions. Canyon soils are shallow over bedrock and do not have a mollic epipedon. These soils are in landscape positions similar to those of the Oglala soils. Rosebud soils have more clay in the control section than the Oglala soils and are moderately deep over bedrock. These soils are in similar landscape positions.

Typical pedon of Oglala loam, in an area of Oglala-Canyon complex, 11 to 30 percent slopes; 2,300 feet north and 400 feet west of the southeast corner of sec. 11, T. 32 N., R. 45 W.

A—0 to 8 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine and medium granular; slightly hard, friable; slightly acid; clear wavy boundary.

AC—8 to 19 inches; grayish brown (10YR 5/2) silt loam, brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; neutral; clear wavy boundary.

C1—19 to 24 inches; light brownish gray (10YR 6/2) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—24 to 58 inches; light gray (10YR 7/2) loam, brown (10YR 5/3) moist; massive; soft, very friable; 2 percent, by volume, sandstone gravel; violent effervescence; moderately alkaline; abrupt wavy boundary.

Cr—58 to 60 inches; white (10YR 8/2), calcareous sandstone; violent effervescence.

The depth to carbonates ranges from 15 to 42 inches. The thickness of the mollic epipedon ranges from 7 to 20 inches. The depth to sandstone ranges from 40 to 60 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is dominantly loam, but the range includes silt loam and very fine sandy loam. The AC horizon has value of 5 to 7 (4 or 5 moist) and chroma of 2 or 3. It is dominantly silt loam, but the range includes loam and very fine sandy loam. The C horizon has value of 6 to 8 (5 or 6 moist) and chroma of 2 or 3. It is dominantly loam, but the range includes silt loam, fine sandy loam, and loamy very fine sand.

Onita Series

The Onita series consists of very deep, moderately well drained, slowly permeable soils in upland swales. These soils formed in loamy and clayey sediments. Slopes range from 0 to 1 percent.

Onita soils are commonly adjacent to Bridget, Keya, and Satanta soils. The adjacent soils have less clay in the control section than the Onita soils. Bridget and

Satanta soils have a mollic epipedon less than 20 inches thick and are higher on the landscape than the Onita soils.

Typical pedon of Onita silty clay loam, 0 to 1 percent slopes, 2,500 feet east and 1,800 feet south of the northwest corner of sec. 9, T. 30 N., R. 45 W.

Ap—0 to 8 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate fine and very fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

Bt1—8 to 18 inches; very dark gray (10YR 3/1) silty clay, black (10YR 2/1) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm; slightly alkaline; clear smooth boundary.

Bt2—18 to 32 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to coarse fine and medium subangular blocky; very hard, firm; slightly alkaline; clear smooth boundary.

Bk—32 to 51 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; fine threads of calcium carbonates; strong effervescence; moderately alkaline; clear smooth boundary.

C—51 to 60 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 20 to 40 inches. The depth to carbonates ranges from 25 to 40 inches.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is dominantly silty clay loam, but the range includes silt loam or loam. The Bt horizon has value of 3 to 5 (2 to 4 moist) and chroma of 1 to 3. It is dominantly silty clay, but the range includes silty clay loam or clay loam. The Bk horizon has value of 4 to 6 (3 to 5 moist) and chroma of 2 to 4. It is dominantly silt loam, but the range includes silty clay loam or clay loam. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4. It is dominantly silt loam, but the range includes silty clay loam or clay loam.

Orella Series

The Orella series consists of shallow, well drained, very slowly permeable soils on uplands. These soils formed in material weathered from shale. Slopes range from 3 to 30 percent.

Orella soils are commonly adjacent to Bufton, Enning, Minnequa, and Thirtynine soils. Bufton soils are very deep. Enning soils formed in material weathered from interbedded chalk and shale. Minnequa soils are moderately deep and formed in material weathered from interbedded chalk and shale. Thirtynine soils are very deep and formed in material weathered from siltstone.

Typical pedon of Orella silty clay loam, in an area of Bufton-Orella complex, 3 to 9 percent slopes; 800 feet west and 300 feet south of the northeast corner of sec. 35, T. 35 N., R. 46 W.

A—0 to 5 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate fine and medium granular structure; hard, firm; strong effervescence; slightly alkaline; clear wavy boundary.

AC—5 to 10 inches; light brownish gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; strong effervescence; slightly alkaline; clear wavy boundary.

C—10 to 16 inches; light gray (2.5Y 7/2) silty clay loam, light grayish brown (2.5Y 6/2) moist; weak coarse prismatic structure; hard, firm; 5 percent, by volume, shale and chalcedony channers; few fine accumulations of salts; percentage of exchangeable sodium—20; strong effervescence; slightly alkaline; clear wavy boundary.

Cr—16 to 60 inches; white (2.5Y 8/2), weathered silty shale.

The depth to carbonates ranges from 0 to 10 inches. The depth to shale ranges from 10 to 20 inches.

The A horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 or 5 moist), and chroma of 1 to 4. It is dominantly silty clay loam, but the range includes silty clay or clay loam. The AC and C horizons have hue of 7.5YR to 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. The control section is dominantly silty clay loam, but the range includes clay or clay loam. The percentage of exchangeable sodium ranges from 8 to 30 percent.

Orpha Series

The Orpha series consists of very deep, excessively drained, rapidly permeable soils on valley side slopes and foot slopes along the Niobrara River and its tributaries. These soils formed in sandy material weathered from sandstone. Slopes range from 3 to 45 percent.

Orpha soils are commonly adjacent to Calamus, Dailey, Jayem, Niobrara, and Valent soils. Calamus soils are stratified sand and are on bottom land. Dailey and Jayem soils are lower on the landscape than the Orpha soils. Valent and Niobrara soils are higher on the landscape. Niobrara soils are also shallow over sandstone. Dailey and Valent soils formed in eolian sand and do not have sandstone fragments. Jayem soils are coarse-loamy and formed in loamy and sandy eolian material.

Typical pedon of Orpha loamy fine sand, in an area of Orpha-Rock outcrop complex, 20 to 60 percent slopes; 100 feet east and 1,300 feet north of the southwest corner of sec. 9, T. 31 N., R. 41 W.

A—0 to 6 inches; grayish brown (10YR 5/2) loamy fine sand, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable; slightly alkaline; clear smooth boundary.

AC—6 to 10 inches; light brownish gray (10YR 6/2) sand, brown (10YR 4/3) moist; single grain; loose; slightly alkaline; clear wavy boundary.

C1—10 to 32 inches; light gray (10YR 7/2) sand, brown (10YR 5/3) moist; single grain; loose; 2 percent, by volume, sandstone gravel; slightly alkaline; clear wavy boundary.

C2—32 to 48 inches; light gray (2.5Y 7/2) fine sand, light brownish gray (2.5Y 6/2) moist; single grain; loose; 9 percent, by volume, sandstone gravel; slight effervescence; moderately alkaline; gradual wavy boundary.

C3—48 to 60 inches; light gray (2.5Y 7/2) fine sand, light brownish gray (2.5Y 6/2) moist; single grain; loose; 12 percent, by volume, sandstone gravel; slight effervescence; moderately alkaline.

The depth to carbonates ranges from 30 to more than 60 inches. The content of sandstone gravel in the control section is less than 15 percent, by volume.

The A horizon has value of 4 to 6 (3 to 5 moist) and chroma of 2 to 4. Texture is loamy fine sand, loamy sand, fine sand, or sand. The C horizon has hue of 10YR or 2.5Y, value of 5 to 8 (4 to 7 moist), and chroma of 2 to 4. It is dominantly sand, but the range includes loamy sand or fine sand.

Ponderosa Series

The Ponderosa series consists of very deep, well drained, moderately rapidly permeable soils on valley sides and foot slopes. These soils formed in sandy and loamy sediments weathered from calcareous sandstone. Slopes range from 3 to 60 percent.

Ponderosa soils are commonly adjacent to Bridget, Busher, Oglala, Tassel, and Vetal soils. Bridget soils are on stream terraces and foot slopes and are coarse-silty. Busher and Oglala soils are on side slopes of uplands and have calcareous sandstone at a depth of 40 to 60 inches. Tassel soils are on knolls, narrow ridgetops, and shoulders and are shallow over calcareous sandstone. Vetal soils are in upland valleys and swales and on toe slopes and have a mollic epipedon more than 20 inches thick.

Typical pedon of Ponderosa very fine sandy loam, in an area of Ponderosa-Tassel-Vetal complex, 6 to 30 percent slopes; 2,000 feet south and 300 feet west of the northeast corner of sec. 4, T. 33 N., R. 44 W.

A—0 to 12 inches; grayish brown (10YR 5/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; neutral; clear wavy boundary.

AC—12 to 21 inches; pale brown (10YR 6/3) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium granular structure; soft, very friable; 2 percent, by volume, sandstone gravel; slightly alkaline; clear wavy boundary.

C1—21 to 27 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable; 4 percent, by volume, sandstone gravel; slightly alkaline; gradual wavy boundary.

C2—27 to 60 inches; very pale brown (10YR 7/3) loamy very fine sand, brown (10YR 5/3) moist; single grain; soft, very friable; 7 percent, by volume, sandstone gravel; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 20 inches. In some pedons the dark surface layer is more than 20 inches thick, but the organic carbon is less than 0.6 percent. The depth to free carbonates ranges from 15 to more than 60 inches. The control section averages more than 35 percent very fine sand and 2 to 15 percent, by volume, sandstone gravel.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 to 3. It is very fine sandy loam or loamy very fine sand. The AC horizon has value of 5 or 6 (3 or 4 moist) and chroma of 2 to 4. It is very fine sandy loam or loamy very fine sand. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4. It is loamy very fine sand or very fine sandy loam.

Rosebud Series

The Rosebud series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in loamy material weathered from calcareous sandstone. Slopes range from 1 to 3 percent.

Rosebud soils are commonly adjacent to Alliance, Canyon, Duroc, Oglala, and Satanta soils. Alliance soils have sandstone at a depth of 40 to 60 inches and are in landscape positions similar to those of the Rosebud soils. Canyon soils do not have a mollic epipedon and have sandstone at a depth of 6 to 20 inches. These soils are higher on the landscape than the Rosebud soils. Duroc soils are very deep and have a mollic epipedon more than 20 inches thick. These soils are lower on the landscape than the Rosebud soils. Oglala soils do not have an argillic horizon and have sandstone at a depth of 40 to 60 inches. These soils are in landscape positions similar to those of the Rosebud soils. Satanta soils do not have sandstone within a depth of 60 inches and are in landscape positions similar to those of the Rosebud soils.

Typical pedon of Rosebud loam, 1 to 3 percent slopes, 1,900 feet east and 1,600 feet south of the northwest corner of sec. 20, T. 34 N., R. 42 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

Bt1—9 to 13 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; clay films on faces of peds; neutral; clear wavy boundary.

Bt2—13 to 17 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; clay films on faces of peds; slightly alkaline; clear wavy boundary.

Bk—17 to 21 inches; very pale brown (10YR 7/3) loam, brown (10YR 5/3) moist; weak fine subangular blocky structure; soft, very friable; 2 percent, by volume, sandstone gravel; soft masses of calcium carbonate; violent effervescence; moderately alkaline; clear wavy boundary.

C—21 to 32 inches; very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist; massive; soft, very friable; 10 percent, by volume, sandstone gravel; violent effervescence; moderately alkaline; clear wavy boundary.

Cr—32 to 60 inches; white (10YR 8/2), calcareous sandstone; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 14 to 26 inches, and the depth to the Cr horizon ranges from 20 to 40 inches. The depth to free carbonates ranges from 10 to 25 inches. The thickness of the mollic epipedon ranges from 7 to 20 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is dominantly loam, but the range includes silt loam. The Bt horizon has value of 4 to 6 (3 or 4 moist) and chroma of 2 or 3. It is dominantly clay loam, but the range includes loam. The C horizon has value of 6 or 7 (5 or 6 moist) and chroma of 3. It is dominantly loam, but the range includes sandy clay loam, sandy loam, and very fine sandy loam.

Satanta Series

The Satanta series consists of very deep, well drained, moderately permeable soils on uplands. These soils formed in loamy eolian material. Slopes range from 0 to 15 percent.

Satanta soils are commonly adjacent to Busher, Dailey, Jayem, Keya, and Tuthill soils. Busher, Dailey, and Jayem soils have more sand in the control section than the Satanta soils and are in similar landscape positions. Busher soils have sandstone at a depth of 40 to 60 inches. Keya soils have a mollic epipedon more than 20 inches thick and are lower on the landscape than the Satanta soils. Tuthill soils have contrasting sandy material in the lower part of the profile and are in landscape positions similar to those of the Satanta soils.

Typical pedon of Satanta fine sandy loam, 0 to 3 percent slopes, 1,150 feet south and 150 feet east of the northwest corner of sec. 20, T. 26 N., R. 46 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure parting to weak very fine granular; slightly hard, very friable; neutral; abrupt smooth boundary.

A—9 to 14 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; neutral; clear smooth boundary.

Bt1—14 to 23 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; moderate coarse subangular blocky structure parting to moderate fine subangular blocky; hard, firm; clay films on faces of peds; neutral; clear smooth boundary.

Bt2—23 to 29 inches; pale brown (10YR 6/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure parting to moderate fine subangular blocky; hard, firm; clay films on faces of peds; neutral; clear smooth boundary.

Bk—29 to 35 inches; light gray (10YR 7/2) loam, grayish brown (10YR 5/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable; violent effervescence; moderately alkaline; clear smooth boundary.

C1—35 to 46 inches; light gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—46 to 60 inches; light gray (10YR 7/2) fine sandy loam, light brownish gray (10YR 6/2) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 40 inches. The thickness of the mollic epipedon ranges from 8 to 20 inches. The depth to free carbonates ranges from 15 to 36 inches. The content of gravel throughout is 0 to 10 percent, by volume.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is dominantly fine sandy loam, but the range includes loam and very fine sandy loam. The Bt horizon has value of 4 to 6 (3 to 5 moist) and chroma of 2 or 3. It is dominantly sandy clay loam, but the range includes loam or clay loam. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3. It is dominantly very fine sandy loam and fine sandy loam, but the range includes loam. Below a depth of 40 inches the C horizon ranges from loam to loamy fine sand.

Tassel Series

The Tassel series consists of shallow, well drained, moderately rapidly permeable soils on uplands. These soils formed in loamy material weathered from calcareous sandstone. Slopes range from 9 to 70 percent.

Tassel soils are commonly adjacent to Busher and Ponderosa soils. Busher soils have a mollic epipedon and have sandstone at a depth of 40 to 60 inches. These soils are lower on the landscape than the Tassel soils. Ponderosa soils have a mollic epipedon, have sandstone below a depth of 60 inches, and are leached of carbonates to a depth of 15 inches or more. They are lower on the landscape than the Tassel soils.

Typical pedon of Tassel fine sandy loam, in an area of Busher-Tassel complex, 6 to 30 percent slopes; 1,000 feet south and 950 feet east of the northwest corner of sec. 8, T. 28 N., R. 46 W.

A—0 to 3 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; strong effervescence; slightly alkaline; clear smooth boundary.

C—3 to 10 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure parting to weak fine granular; soft, very friable; 10 percent, by volume, sandstone gravel; violent effervescence; moderately alkaline; clear wavy boundary.

Cr—10 to 60 inches; white (10YR 8/2), calcareous sandstone; violent effervescence.

The depth to free carbonates ranges from 0 to 3 inches. The depth to the Cr horizon ranges from 6 to 20 inches.

The A horizon has value of 4 to 6 (3 to 5 moist) and chroma of 2 or 3. It is dominantly fine sandy loam, but the range includes very fine sandy loam and loamy fine sand. The C horizon has value of 6 to 8 (4 to 6 moist) and chroma of 2 or 3. It is dominantly fine sandy loam, but the range includes sandy loam, very fine sandy loam, and loamy very fine sand.

Thirtynine Series

The Thirtynine series consists of very deep, well drained, moderately permeable soils on uplands. These soils formed in loamy material weathered from siltstone. Slopes range from 1 to 9 percent.

Thirtynine soils are commonly adjacent to Bridget, Epping, McCook, and Mitchell soils. Bridget soils are lower on the landscape than the Thirtynine soils. Bridget and Mitchell soils have less clay in the control section than the Thirtynine soils. Epping soils are shallow over bedded siltstone and are higher on the landscape than the Thirtynine soils. McCook soils are on bottom land and are stratified. Mitchell soils are in landscape positions similar to those of the Thirtynine soils.

Typical pedon of Thirtynine loam, 6 to 9 percent slopes, 1,700 feet north and 300 feet east of the southwest corner of sec. 1, T. 34 N., R. 46 W.

A—0 to 8 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; soft, friable; neutral; clear wavy boundary.

Bt1—8 to 13 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, firm; thin clay films on faces of peds; neutral; clear wavy boundary.

Bt2—13 to 21 inches; light brownish gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) moist; moderate coarse prismatic structure parting to

moderate medium subangular blocky; hard, firm; thin patchy clay films on faces of peds; slightly alkaline; clear wavy boundary.

Bk—21 to 25 inches; light gray (10YR 7/2) silt loam, light brownish gray (10YR 6/2) moist; weak coarse prismatic structure parting to weak fine and medium subangular blocky; soft, friable; few fine filaments of carbonates; violent effervescence; moderately alkaline; gradual wavy boundary.

C—25 to 60 inches; very pale brown (10YR 7/3) very fine sandy loam, pale brown (10YR 6/2) moist; massive; soft, very friable; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 15 to 30 inches. The depth to free carbonates ranges from 15 to 28 inches. The thickness of the mollic epipedon ranges from 8 to 20 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is dominantly loam, but the range includes silt loam. The Bt horizon has value of 5 to 7 (3 to 5 moist) and chroma of 2 to 4. It is dominantly silty clay loam, loam, or silt loam. The content of clay ranges from 20 to 35 percent. The C horizon has hue of 10YR or 7.5YR, value of 7 or 8 (5 or 6 moist), and chroma of 2 to 4. It is silt loam, loam, or very fine sandy loam.

Tryon Series

The Tryon series consists of very deep, poorly drained and very poorly drained, rapidly permeable soils in sandhill valleys. They formed in eolian sand and sandy alluvium. Slopes range from 0 to 1 percent.

Tryon soils are commonly adjacent to Els, Ipage, and Marlake soils. Els soils are somewhat poorly drained and are higher on the landscape than the Tryon soils. Ipage soils are moderately well drained and have more sand in the solum than the Tryon soils. These soils are higher on the landscape. Marlake soils are lower on the landscape than the Tryon soils and have water on the surface for most of the growing season.

Typical pedon of Tryon fine sandy loam, 0 to 1 percent slopes, 1,900 feet north and 750 feet west of the southeast corner of sec. 20, T. 28 N., R. 41 W.

A—0 to 6 inches; very dark grayish brown (10YR 3/2) fine sandy loam, black (10YR 2/1) moist; moderate fine granular structure; soft, very friable; moderately acid; gradual smooth boundary.

C1—6 to 15 inches; light brownish gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; single grain; loose; slightly acid; gradual smooth boundary.

C2—15 to 25 inches; light brownish gray (2.5Y 6/2) loamy fine sand, grayish brown (2.5Y 5/2) moist; many coarse and medium prominent yellowish brown (10YR 5/6 moist) mottles; single grain; soft, very friable; moderately acid; gradual smooth boundary.

C3—25 to 60 inches; light gray (10YR 7/2) fine sand, grayish brown (10YR 5/2) moist; single grain; loose; slightly acid.

Free carbonates, if they occur, are in the surface layer.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is dominantly fine sandy loam, but the range includes loamy fine sand, fine sand, and loam. The C horizon has value of 5 to 8 (4 to 7 moist) and chroma of 2 or 3. It is sand, fine sand, loamy sand, or loamy fine sand. In some pedons strata of dark fine sandy loam or loam are below a depth of 40 inches.

Tuthill Series

The Tuthill series consists of very deep, well drained soils on uplands. These soils formed in sandy and loamy material of mixed origin. Permeability is moderate in the subsoil and rapid in the underlying material (fig. 24). Slopes range from 0 to 11 percent.

Tuthill soils are commonly adjacent to Jayem, Keya, Satanta, and Vetal soils. Jayem soils have less silt and clay in the control section than the Tuthill soils and are in similar landscape positions. Keya and Vetal soils have a mollic epipedon more than 20 inches thick and are lower on the landscape than the Tuthill soils. Satanta soils do not have contrasting sandy material in the lower part of the profile and are in landscape positions similar to those of the Tuthill soils.

Typical pedon of Tuthill fine sandy loam, 3 to 6 percent slopes, 350 feet west and 900 feet north of the southeast corner of sec. 24, T. 32 W., R. 41 W.

A—0 to 9 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure parting to moderate fine granular; soft, very friable; slightly alkaline; clear smooth boundary.

Bt1—9 to 14 inches; dark brown (10YR 4/3) sandy clay loam, very dark grayish brown (10YR 3/2) moist; strong medium prismatic structure parting to moderate medium subangular blocky; hard, firm; thin patchy clay films on faces of peds; slightly alkaline; clear wavy boundary.

Bt2—14 to 21 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; strong coarse prismatic structure parting to moderate medium

subangular blocky; hard, firm; thin patchy clay films on faces of peds; neutral; clear wavy boundary.

2C1—21 to 24 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; single grain; loose; neutral; gradual wavy boundary.

2C2—24 to 60 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; single grain; loose; neutral.

The depth to free carbonates ranges from 36 to more than 60 inches. The thickness of the mollic epipedon ranges from 7 to 20 inches. The depth to the contrasting 2C horizon ranges from 20 to 40 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is dominantly fine sandy loam or loamy fine sand. The Bt horizon has value of 4 to 6 (3 or 4 moist) and chroma of 2 or 3. It is dominantly sandy clay loam, but the range includes fine sandy loam, clay loam, loam, and sandy loam in which the content of clay ranges from 18 to 27 percent. The 2C horizon has value of 6 to 8 (5 to 7 moist) and chroma of 2 or 3. It is fine sand, loamy sand, or loamy fine sand. In some pedons strata of loam or sandy loam are at a depth of 40 to 60 inches.

Valent Series

The Valent series consists of very deep, excessively drained, rapidly permeable soils in the sandhills. These soils formed in eolian sand (fig. 25). Slopes range from 0 to 60 percent.

Valent soils are commonly adjacent to Dailey, Els, Hoffland, Ipage, and Wildhorse soils. Dailey soils have a mollic epipedon and are lower on the landscape than the Valent soils. Els soils are somewhat poorly drained and are lower on the landscape than the Valent soils. Hoffland soils are poorly drained and very poorly drained and are lower on the landscape than the Valent soils. Ipage soils are moderately well drained and are lower on the landscape than the Valent soils. Wildhorse soils are very strongly alkaline and are lower on the landscape than the Valent soils.

Typical pedon of Valent fine sand, rolling, 1,600 feet north and 1,800 feet west of the southeast corner of sec. 10, T. 27 N., R. 44 W.

A—0 to 4 inches; grayish brown (10YR 5/2) fine sand, dark grayish brown (10YR 4/2) moist; single grain; loose; neutral; clear smooth boundary.

C—4 to 60 inches; pale brown (10YR 6/3) fine sand, grayish brown (10YR 5/2) moist; single grain; loose; slightly alkaline.

Reaction is neutral or slightly alkaline throughout the profile.

The A horizon has value of 4 to 6 (3 to 5 moist) and chroma of 2. It is dominantly fine sand, but the range includes loamy fine sand. Some pedons have an AC horizon. The C horizon has value of 5 to 7 (5 or 6 moist) and chroma of 2 to 4. It is dominantly fine sand, but the range includes loamy fine sand and sand.

Valentine Series

The Valentine series consists of very deep, excessively drained, rapidly permeable soils in the sandhills. These soils formed in eolian sand. Slopes range from 3 to 60 percent.

Valentine soils are commonly adjacent to Els, Ipage, and Tryon soils. The adjacent soils are lower on the landscape than the Valentine soils. Els soils are somewhat poorly drained, Ipage soils are moderately well drained, and Tryon soils are poorly drained and very poorly drained.

Typical pedon of Valentine fine sand, rolling, 2,000 feet north and 2,200 feet west of the southeast corner of sec. 27, T. 35 N., R. 41 W.

A—0 to 6 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grain; loose; slightly acid; gradual wavy boundary.

C—6 to 60 inches; very pale brown (10YR 7/4) fine sand, light yellowish brown (10YR 6/4) moist; single grain; loose; neutral.

Reaction is slightly acid or neutral throughout the profile.

The A horizon has value of 4 to 6 (3 to 5 moist) and chroma of 2 or 3. It is dominantly fine sand, but the range includes loamy fine sand. The AC horizon, if it occurs, has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3. The C horizon has value of 6 or 7 (5 or 6 moist) and chroma of 2 to 4. It is dominantly fine sand, but the range includes loamy fine sand.

Vetal Series

The Vetal series consists of very deep, well drained, moderately rapidly permeable soils on foot slopes and in upland swales. These soils formed in loamy and sandy alluvium and eolian sediments. Slopes range from 0 to 9 percent.

Vetal soils are commonly adjacent to Busher, Dailey, Jayem, Ponderosa, and Tuthill soils. The adjacent soils have a mollic epipedon less than 20 inches thick and are higher on the landscape than the Vetal soils. Busher soils have soft, calcareous sandstone at a depth of 40 to 60 inches. Dailey soils are sandy. Tuthill soils have more clay in the profile than the Vetal soils.

Typical pedon of Vetal fine sandy loam, 0 to 2 percent slopes, 150 feet east and 2,400 feet south of the northwest corner of sec. 8, T. 28 N., R. 46 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak fine granular structure; soft, very friable; neutral; abrupt smooth boundary.

A1—7 to 17 inches; dark gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak coarse subangular blocky structure parting to weak fine granular; soft, very friable; neutral; clear smooth boundary.

A2—17 to 31 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; soft, very friable; neutral; clear wavy boundary.

AC—31 to 43 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to weak fine granular; soft, very friable; neutral; clear wavy boundary.

C—43 to 60 inches; light gray (10YR 7/2) fine sand, grayish brown (10YR 5/2) moist; single grain; loose; 2 percent, by volume, sandstone gravel; strong effervescence; slightly alkaline.

The thickness of the solum and the mollic epipedon range from 24 to 50 inches. Free carbonates are below a depth of 30 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is dominantly fine sandy loam or loamy fine sand, but the range includes very fine sandy loam. The AC horizon has value of 4 or 5 (3 or 4 moist) and chroma of 1 to 3. It is dominantly fine sandy loam, but the range includes sandy loam, loam, and very fine sandy loam. The C horizon has value of 5 to 7 (4 or 5 moist) and chroma of 2 or 3. It is dominantly fine sandy loam, sandy loam, or very fine sandy loam. Sand, fine sand, loamy sand, or loamy fine sand is common below a depth of 40 inches.

Wildhorse Series

The Wildhorse series consists of very deep, somewhat poorly drained, rapidly permeable soils in sandhill valleys. These soils formed in eolian sand and sandy alluvium. Slopes range from 0 to 3 percent.

Wildhorse soils are commonly adjacent to Crowther, Els, Hoffland, and Ipage, calcareous, soils. Crowther and Hoffland soils have a calcic horizon, are poorly drained and very poorly drained, and are lower on the landscape than the Wildhorse soils. Els soils are not affected by sodium and other salts and are in landscape positions similar to those of the Wildhorse soils. Ipage, calcareous, soils are better drained than the Wildhorse soils and are higher on the landscape.

Typical pedon of Wildhorse fine sand, 0 to 3 percent slopes, 1,650 feet west and 2,450 feet north of the southeast corner of sec. 28, T. 27 N., R. 44 W.

A—0 to 5 inches; grayish brown (10YR 5/2) fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; percentage of exchangeable sodium—48; sodium adsorption ratio 42; strong effervescence; very strongly alkaline; clear smooth boundary.

AC—5 to 10 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; single grain; loose; percentage of exchangeable sodium—31; sodium adsorption ratio 17; violent effervescence; very strongly alkaline; clear smooth boundary.

C1—10 to 24 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; common medium prominent very dark grayish brown (2.5Y 3/2 moist) mottles; single grain; loose; percentage of exchangeable sodium—12; sodium adsorption ratio 4; violent effervescence; very strongly alkaline; gradual smooth boundary.

C2—24 to 42 inches; light gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; common medium prominent very dark grayish brown (2.5Y 3/2 moist) mottles; single grain; loose; percentage of exchangeable sodium—15; sodium adsorption ratio 9; strong effervescence; very strongly alkaline; clear smooth boundary.

C3—42 to 60 inches; light gray (10YR 6/1) fine sand, gray (10YR 5/1) moist; many coarse prominent olive gray (5Y 5/2 moist) mottles; single grain; loose; percentage of exchangeable sodium—8; sodium adsorption ratio 7; strongly alkaline.

The percentage of exchangeable sodium is more than 15 and the sodium adsorption ratio is more than 13 in half or more of the upper 20 inches of the profile.

The A horizon has value of 4 to 6 (3 to 5 moist) and chroma of 1 or 2. It is dominantly fine sand, but the range includes loamy fine sand. The C horizon has value of 6 to 8 (4 to 7 moist) and chroma of 1 or 2. It is dominantly fine sand, but the range includes sand and loamy fine sand. In some pedons the C horizon has strata of loamy fine sand and fine sandy loam.

Formation of the Soils

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of the soil are determined by the physical and mineralogical composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time that the forces of soil formation have acted on the soil material.

Climate and plant and animal life, mainly plants, are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material affects the kind of soil that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for the transformation of the parent material into a soil. Generally, a long time is needed for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four.

Climate

Climate has had an important effect on soil formation in Sheridan County by its direct effect on the parent material and its indirect effect on vegetation and micro-organisms.

The climatic factors that affect soil formation are rainfall, fluctuating temperatures, and wind. Runoff of rainwater removes, relocates, and sorts the soil material. The wind removes, sorts, and deposits the soil material. The extensive deposits of eolian sand in the county are examples of the importance of the wind as a soil-forming agent. Alternating periods of freezing and thawing and of wetting and drying speed the chemical and mechanical weathering processes and loosen and mix the soil material, thus improving the physical condition of the soil.

Micro-organisms in the soil are the most active at a defined temperature range. Thus, the rate at which organic matter is decomposed into humus varies with the climatic conditions. Changes in temperature and moisture activate the weathering of parent material, which results in chemical and physical changes in the soil.

Because the humidity in Sheridan County is generally low, the soil loses a fairly high amount of water through evaporation and transpiration. Thus, the soil has less decomposition of organic matter and chemical weathering.

Parent Material

Parent material is the weathered or partly weathered material in which a soil forms. It affects the chemical and mineralogical composition of the soil. The soils in Sheridan County formed in eolian sand, loess, material weathered from sandstone, siltstone, shale, and interbedded chalk and shale, and alluvium or colluvium.

Eolian sand is the most extensive parent material in the county and the dominant parent material in the sandhills. It is material that was deposited by the wind and consisting mainly of quartz and feldspar minerals. The thickness of the sand deposit ranges from 1 foot to several hundred feet. Except for a slightly darkened layer at the surface, soils formed in eolian sand show little horizon development. Dailey, Ipage, and Valent soils formed in eolian sand.

Loess is a major parent material of many of the soils north of the sandhills. This windblown material is believed to be the fine sediments blown out of ancient river and stream valleys. It is a brownish and yellowish deposit ranging in thickness from 1 to about 8 feet. Alliance and Keith soils formed in loess and generally have good horizon development.

Material weathered from sandstone is a major parent material of the soils north of the sandhills and through the Pine Ridge area. The soils formed in place or they formed in material that was locally reworked and transported by the wind. These deposits range in thickness from a few inches to several feet. Except for a slightly darkened surface layer, most of the soils that formed in this material have weakly developed horizons. Busher, Canyon, Oglala, and Ponderosa

soils formed in this material. Most of the material in Jayem soils also weathered from sandstone, but it has been locally reworked by the wind and possibly contains material from other sources.

Material weathered from siltstone, shale, and interbedded chalk and shale are common parent materials in the northwestern part of the county. The weathered material ranges from a few inches to several feet thick. Epping, Kadoka, Mitchell, and Thirtynine soils formed in material weathered from siltstone. Bufton soils formed in material weathered from shale and have a higher content of clay. Enning, Manvel, and Minnequa soils formed in material weathered from interbedded chalk and shale.

Alluvium is material that has been deposited by water. It consists of loamy and sandy material washed from the higher areas and deposited on bottom land along drainageways. The deposits range in thickness from a few feet to more than 20 feet. They are young and, except for the dark surface layer, generally do not have clearly defined horizons. Almeria, Beckton, Bolent, Lute, and McCook soils formed in alluvium. Beckton and Lute soils have a well developed subsoil.

Colluvium consists of material that has been moved downslope from the higher areas and accumulated at the base of slopes, along small streams, and in swales through the action of gravity, soil creep, and local wash. These deposits are generally less than 10 feet thick. Except for the dark surface layer, soils formed in this material have only weakly developed soil horizons. Duroc soils formed in this material.

In some areas of the county, soils formed in a mixture of different types of parent material or in areas where younger parent material was deposited over older parent material. Examples of soils formed in more than one type of parent material are Johnstown soils, which formed in loess and loamy sediments deposited over gravelly sands.

Plant and Animal Life

Plants, burrowing animals, micro-organisms, earthworms, and other living organisms affect soil formation. The soils in Sheridan County formed mainly under a mixture of short, mid, and tall grasses. Every year, the grasses grew and their fibrous roots penetrated the upper few feet of the soil. In time, a dark layer formed on the surface. This layer gradually thickened as more organic matter decayed into humus. Because of the additional humus, the soils developed a granular structure and good tilth. Plant roots bring nutrients to the surface. Calcium is particularly helpful in keeping the soils more porous. Organic acids form during the decomposition of organic material. In solution, these acids hasten the leaching process.

Micro-organisms act on the undecomposed organic matter and help change it into humus. Some bacteria take in nitrogen from the air. As they die, they release nitrogen available to plants. Other bacteria oxidize sulphur, which then becomes available to plants. The plants, in turn, complete the cycle by producing more organic matter. Other living organisms, such as algae, fungi, protozoa, and actinomycetes, affect the physical and chemical makeup of the soil. Larger animals, such as gophers and moles, and earthworms, millipedes, spiders, and other insects help in mixing the soil and in adding organic matter after they die.

Human activities have a major effect on soil formation. Because of cropping sequences, drainage systems, irrigation, and summer fallow, the relationships among soil, water, and erosion that existed for several thousand years have changed. Removing the grass cover has exposed the fertile surface layer to erosion. Drainage systems have increased chemical activity and weathering in the poorly drained soils. Irrigation and summer fallow have increased the moisture supply and the rates of chemical weathering and water movement.

Relief

Relief influences soil formation mainly through its effect on runoff, erosion, aeration, and drainage. The rate of runoff is more rapid on the steep and very steep soils than on the less sloping soils. Consequently, plant growth generally is less vigorous on the steeper soils, the surface absorbs less water, soil horizons are thinner and less distinct, the lime is not leached to so great a depth as it is in the less sloping soils, and, if all other factors are equal, the hazard of erosion is more severe on the steeper soils.

The nearly level and gently sloping soils on uplands in Sheridan County are characterized by stronger profile development and more distinct horizons than the steeper soils. They absorb more moisture, have less runoff, and water percolates deeper into the profile. Consequently, more leaching of lime, plant nutrients, and clay particles occurs in these soils, and well developed and distinct horizons form. The nearly level and gently sloping Alliance and Satanta soils have fairly well developed profiles.

On steep slopes where runoff is rapid and little moisture penetrates the soil, the rate of soil formation is slower than that in the soils on the gentler slopes. Erosion removes the surface soil almost as fast as it

forms. Lime and other elements are not leached to so great a depth as they are in the less sloping soils. Because the soils on ridges and hilltops are more exposed to air currents than the soils in the lower areas, they are more susceptible to the loss of moisture through evaporation. The steep Canyon and Tassel soils have little evidence of profile development other than a slightly darkened, thin surface layer.

In upland depressions, runoff is slow and the soils receive runoff from the higher areas. Because of the extra moisture, Lodgepole soils have a thick, dark surface layer and good horizon development.

The soils on bottom land have very little relief, but their position on the landscape has an influence on soil development in the young parent material. Some of these soils have a high water table, which affects decomposition of organic matter, soil temperature, and alkalinity. Other soils on bottom land are subject to flooding and to continuous deposition of sediments. All of these influences have an effect on the kind and amount of vegetation and on soil development. The well drained McCook and Munjor soils on bottom land are rarely flooded to frequently flooded. Hoffland and Wildhorse soils on bottom land are affected by alkalinity and a high water table.

The soils in the sandhills, such as Valent soils, are not affected as much by slope, runoff, and internal drainage as by erosion and the resistance of the sandy material to chemical weathering. These soils show little horizon development.

Time

Time is needed for relief, climate, and plant and animal life to change the parent material into a soil. If the parent material has been in place for only a short time, the soils are weakly developed. The degree of profile development depends on the intensity of the soil-forming factors. The distinctness of horizons in the soil profile commonly reflects the length of time that the geological material has been in place.

The time needed for a soil to form depends mainly on the kind of parent material and the climate. The resistance of the parent material to weathering partly determines the length of time that is needed for a soil to form. Generally, soils in warm, humid areas form more rapidly than soils in cool, dry areas.

The maturity of soils is related not only to time but also to the other four soil-forming factors. Soils that do not have a B horizon are commonly considered immature, and soils that have a well developed B horizon are considered mature. The maturity of a soil, however, depends on the interaction of all five soil-forming factors. Thus, the very steep Ponderosa soils, which do not have a B horizon, may be as mature as they can be on their particular slopes and under their particular climate.

References

(1) American Association of State Highway and Transportation Officials. 1986. Standard specifications for highway materials and methods of sampling and testing. Ed. 14, 2 vols.

(2) American Society for Testing and Materials. 1993. Standard classification of soils for engineering purposes. ASTM Stand. D 2487.

(3) Nebraska Game and Parks Commission. 1987. State Comprehensive Outdoor Recreation Plan (SCORP).

(4) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436.

(5) United States Department of Agriculture. 1983. Nebraska irrigation guide. Soil Conserv. Serv.

(6) United States Department of Agriculture. 1993. Soil survey manual. U.S. Dep. Agric. Handb. 18.

(7) Winston, Christina. 1960. History of Sheridan County.

Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. A shallow depression from which all or most of the soil material has been removed by the wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or “chain,” of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for

significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess salt (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sodium (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, or clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed

waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and are less palatable to livestock.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by the wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single*

grain (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material that is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Too arid (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-87 at Hay Springs, Nebraska)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	35.3	10.2	22.8	61	-24	0	0.53	0.25	0.80	2	8.2
February----	40.8	15.2	28.0	67	-17	1	.66	.27	.99	2	9.2
March-------	47.2	21.2	34.2	76	-9	7	1.34	.54	2.01	4	11.7
April-------	59.1	31.3	45.2	84	7	53	2.45	1.35	3.42	5	7.1
May---------	69.9	41.8	55.9	90	23	215	3.30	1.71	4.68	6	.5
June--------	80.0	51.2	65.6	99	34	469	3.44	2.06	4.67	7	.1
July--------	88.0	57.4	72.7	104	43	701	3.12	1.87	4.25	5	.0
August------	86.7	55.6	71.2	101	40	654	1.78	.73	2.75	4	.0
September---	76.8	44.6	60.7	97	23	340	1.39	.40	2.26	3	.5
October-----	64.3	33.4	48.8	87	14	94	1.13	.40	1.73	3	2.5
November----	47.2	21.1	34.2	74	-5	4	.75	.35	1.13	2	8.0
December----	38.0	13.3	25.6	65	-18	0	.63	.23	.97	2	9.3
Yearly:											
Average---	61.1	33.0	47.1	---	---	---	---	---	---	---	---
Extreme---	110	-31	---	104	-25	---	---	---	---	---	---
Total-----	---	---	---	---	---	2,537	20.52	15.79	23.42	45	57.0

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-87 at Hay Springs, Nebraska)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 9	May 20	May 30
2 years in 10 later than--	May 3	May 13	May 25
5 years in 10 later than--	Apr. 21	May 1	May 14
First freezing temperature in fall:			
1 year in 10 earlier than--	Sept. 23	Sept. 17	Sept. 10
2 years in 10 earlier than--	Sept. 29	Sept. 22	Sept. 15
5 years in 10 earlier than--	Oct. 9	Oct. 1	Sept. 23

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-87 at Hay Springs, Nebraska)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	146	128	114
8 years in 10	154	136	120
5 years in 10	170	152	132
2 years in 10	185	168	143
1 year in 10	193	176	150

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ac	Alliance loam, 0 to 1 percent slopes	1,630	0.1
AcB	Alliance loam, 1 to 3 percent slopes	16,160	1.0
AcC	Alliance loam, 3 to 6 percent slopes	17,710	1.1
An	Almeria loamy fine sand, channeled, 0 to 2 percent slopes	970	0.1
Bc	Bankard loamy fine sand, channeled, 0 to 2 percent slopes	340	*
Bd	Beckton silt loam, 0 to 2 percent slopes	16,210	1.0
Bf	Bolent loamy fine sand, 0 to 2 percent slopes	2,780	0.2
Bh	Bridget very fine sandy loam, 0 to 1 percent slopes	3,190	0.2
BhB	Bridget very fine sandy loam, 1 to 3 percent slopes	6,160	0.4
Bm	Bridget loam, 0 to 1 percent slopes	4,200	0.3
BnB	Bufton silty clay loam, 1 to 3 percent slopes	1,630	0.1
BnE	Bufton silty clay loam, 9 to 20 percent slopes	2,130	0.1
BoD	Bufton-Orella complex, 3 to 9 percent slopes	2,440	0.2
BsB	Busher fine sandy loam, 0 to 3 percent slopes	2,010	0.1
BsC	Busher fine sandy loam, 3 to 6 percent slopes	6,470	0.4
BsD	Busher fine sandy loam, 6 to 9 percent slopes	6,290	0.4
BvC	Busher-Tassel complex, 0 to 6 percent slopes	3,340	0.2
BvF	Busher-Tassel complex, 6 to 30 percent slopes	14,020	0.9
Ca	Calamus loamy fine sand, 0 to 2 percent slopes	4,100	0.3
Cr	Crowther loam, 0 to 1 percent slopes	1,740	0.1
Cs	Crowther loam, wet, 0 to 1 percent slopes	2,310	0.1
DuB	Dailey loamy fine sand, 0 to 3 percent slopes	45,200	2.9
DuD	Dailey loamy fine sand, 3 to 9 percent slopes	40,860	2.6
Dw	Duroc loam, 0 to 1 percent slopes	4,850	0.3
DwB	Duroc loam, 1 to 3 percent slopes	7,010	0.4
Ec	Els fine sand, calcareous, 0 to 2 percent slopes	4,200	0.3
Ef	Els, calcareous-Hoffland complex, 0 to 2 percent slopes	6,840	0.4
EgB	Els, calcareous-Ipage complex, 0 to 3 percent slopes	12,960	0.8
En	Els, calcareous-Tryon complex, 0 to 2 percent slopes	1,100	0.1
Es	Elsmere loamy fine sand, 0 to 2 percent slopes	2,440	0.2
EuE	Enning-Minnequa complex, 6 to 20 percent slopes	3,340	0.2
EvG	Enning-Rock outcrop complex, 9 to 40 percent slopes	9,420	0.6
EwG	Epping-Badland complex, 3 to 60 percent slopes	3,970	0.3
Fu	Fluvaquents, sandy, 0 to 1 percent slopes	300	*
Gg	Gannett loam, 0 to 1 percent slopes	1,070	0.1
Gh	Gannett loam, wet, 0 to 1 percent slopes	1,410	0.1
Hm	Hoffland fine sandy loam, 0 to 1 percent slopes	1,680	0.1
Hn	Hoffland fine sandy loam, wet, 0 to 1 percent slopes	2,740	0.2
IpB	Ipage fine sand, 0 to 3 percent slopes	14,380	0.9
JgB	Jayem fine sandy loam, 0 to 3 percent slopes	7,030	0.4
JgC	Jayem fine sandy loam, 3 to 6 percent slopes	7,680	0.5
JgD	Jayem fine sandy loam, 6 to 9 percent slopes	990	0.1
Jo	Johnstown loam, 0 to 1 percent slopes	4,510	0.3
Kd	Kadoka silt loam, 0 to 2 percent slopes	970	0.1
KdC	Kadoka silt loam, 2 to 6 percent slopes	980	0.1
KdD	Kadoka silt loam, 6 to 9 percent slopes	4,190	0.3
Ke	Keith loam, 0 to 1 percent slopes	9,660	0.6
KeB	Keith loam, 1 to 3 percent slopes	11,970	0.8
KeC	Keith loam, 3 to 6 percent slopes	2,340	0.1
Kg	Keith loam, gravelly substratum, 0 to 1 percent slopes	9,580	0.6
KgB	Keith loam, gravelly substratum, 1 to 3 percent slopes	1,300	0.1
KgC	Keith loam, gravelly substratum, 3 to 6 percent slopes	280	*
Ky	Keya loam, 0 to 2 percent slopes	29,020	1.8
La	Las Animas loam, 0 to 2 percent slopes	1,020	0.1
Lg	Lodgepole silt loam, 0 to 1 percent slopes	1,290	0.1
Lu	Lute loam, 0 to 2 percent slopes	5,800	0.4
MbC	Manvel silty clay loam, 2 to 6 percent slopes	1,860	0.1
Mc	Marlake fine sandy loam, 0 to 1 percent slopes	6,580	0.4
Mk	McCook loam, 0 to 2 percent slopes	4,320	0.3
Mm	McCook loam, channeled, 0 to 2 percent slopes	2,130	0.1
MxF	Mitchell-Epping complex, 9 to 30 percent slopes	5,390	0.3
My	Munjor fine sandy loam, 0 to 2 percent slopes	3,250	0.2

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
Mz	Munjor fine sandy loam, channeled, 0 to 2 percent slopes	5,530	0.3
OhC	Oglala-Canyon complex, 3 to 6 percent slopes	24,530	1.6
OhD	Oglala-Canyon complex, 6 to 11 percent slopes	54,430	3.4
OhF	Oglala-Canyon complex, 11 to 30 percent slopes	22,650	1.4
On	Onita silty clay loam, 0 to 1 percent slopes	460	*
OrF	Orella silty clay loam, 3 to 30 percent slopes	1,190	0.1
OvD	Orpha loamy fine sand, 3 to 9 percent slopes	1,060	0.1
OwF	Orpha-Niobrara complex, 9 to 30 percent slopes	13,020	0.8
OxG	Orpha-Rock outcrop complex, 20 to 60 percent slopes	14,300	0.9
PoC	Ponderosa very fine sandy loam, 3 to 6 percent slopes	1,890	0.1
PoD	Ponderosa very fine sandy loam, 6 to 9 percent slopes	5,010	0.3
PtF	Ponderosa-Tassel-Vetal complex, 6 to 30 percent slopes	43,370	2.7
RoB	Rosebud loam, 1 to 3 percent slopes	5,240	0.3
SnB	Satanta fine sandy loam, 0 to 3 percent slopes	12,760	0.8
SnC	Satanta fine sandy loam, 3 to 6 percent slopes	12,740	0.8
SnD	Satanta fine sandy loam, 6 to 11 percent slopes	3,090	0.2
SsD	Satanta-Canyon complex, 6 to 11 percent slopes	15,750	1.0
SsE	Satanta-Canyon complex, 11 to 20 percent slopes	3,450	0.2
TfG	Tassel-Rock outcrop complex, 9 to 70 percent slopes	9,350	0.6
TgG	Tassel-Ponderosa-Rock outcrop association, 9 to 70 percent slopes	80,340	5.1
ThB	Thirtynine loam, 1 to 3 percent slopes	3,220	0.2
ThC	Thirtynine loam, 3 to 6 percent slopes	4,080	0.3
ThD	Thirtynine loam, 6 to 9 percent slopes	7,110	0.4
To	Tryon fine sandy loam, 0 to 1 percent slopes	5,010	0.3
Tp	Tryon fine sandy loam, wet, 0 to 1 percent slopes	2,670	0.2
TtB	Tuthill loamy fine sand, 0 to 3 percent slopes	5,530	0.3
TtD	Tuthill loamy fine sand, 3 to 9 percent slopes	16,150	1.0
TwB	Tuthill fine sandy loam, 0 to 3 percent slopes	22,470	1.4
TwC	Tuthill fine sandy loam, 3 to 6 percent slopes	24,400	1.5
TwD	Tuthill fine sandy loam, 6 to 11 percent slopes	5,360	0.3
VaB	Valent fine sand, 0 to 3 percent slopes	23,570	1.5
VaD	Valent fine sand, 3 to 9 percent slopes	120,630	7.6
VaE	Valent fine sand, rolling	209,270	13.2
VaF	Valent complex, rolling and hilly	159,360	10.1
VaG	Valent fine sand, hilly	71,880	4.5
VeB	Valent loamy fine sand, 0 to 3 percent slopes	3,110	0.2
VeD	Valent loamy fine sand, 3 to 9 percent slopes	8,480	0.5
VnD	Valentine fine sand, 3 to 9 percent slopes	10,770	0.7
VnE	Valentine fine sand, rolling	13,900	0.9
VnF	Valentine complex, rolling and hilly	34,610	2.2
VnG	Valentine fine sand, hilly	7,580	0.5
VsB	Vetal loamy fine sand, 0 to 3 percent slopes	4,850	0.3
Vt	Vetal fine sandy loam, 0 to 2 percent slopes	16,300	1.0
WrB	Wildhorse fine sand, 0 to 3 percent slopes	9,970	0.6
WsB	Wildhorse-Hoffland complex, 0 to 3 percent slopes	18,880	1.2
WtB	Wildhorse-Ipage, calcareous complex, 0 to 3 percent slopes	27,370	1.7
	Water areas more than 40 acres in size	12,470	0.8
	Water areas less than 40 acres in size	1,289	0.1
	Total	1,582,189	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
Ac	Alliance loam, 0 to 1 percent slopes (where irrigated)
AcB	Alliance loam, 1 to 3 percent slopes (where irrigated)
AcC	Alliance loam, 3 to 6 percent slopes (where irrigated)
Bh	Bridget very fine sandy loam, 0 to 1 percent slopes (where irrigated)
BhB	Bridget very fine sandy loam, 1 to 3 percent slopes (where irrigated)
Bm	Bridget loam, 0 to 1 percent slopes (where irrigated)
BsB	Busher fine sandy loam, 0 to 3 percent slopes (where irrigated)
BsC	Busher fine sandy loam, 3 to 6 percent slopes (where irrigated)
Dw	Duroc loam, 0 to 1 percent slopes (where irrigated)
DwB	Duroc loam, 1 to 3 percent slopes (where irrigated)
JgB	Jayem fine sandy loam, 0 to 3 percent slopes (where irrigated)
JgC	Jayem fine sandy loam, 3 to 6 percent slopes (where irrigated)
Jo	Johnstown loam, 0 to 1 percent slopes (where irrigated)
Kd	Kadoka silt loam, 0 to 2 percent slopes (where irrigated)
KdC	Kadoka silt loam, 2 to 6 percent slopes (where irrigated)
Ke	Keith loam, 0 to 1 percent slopes (where irrigated)
KeB	Keith loam, 1 to 3 percent slopes (where irrigated)
KeC	Keith loam, 3 to 6 percent slopes (where irrigated)
Kg	Keith loam, gravelly substratum, 0 to 1 percent slopes (where irrigated)
KgB	Keith loam, gravelly substratum, 1 to 3 percent slopes (where irrigated)
KgC	Keith loam, gravelly substratum, 3 to 6 percent slopes (where irrigated)
Ky	Keya loam, 0 to 2 percent slopes (where irrigated)
La	Las Animas loam, 0 to 2 percent slopes (where drained)
Mk	McCook loam, 0 to 2 percent slopes (where irrigated)
My	Munjor fine sandy loam, 0 to 2 percent slopes (where irrigated)
PoC	Ponderosa very fine sandy loam, 3 to 6 percent slopes (where irrigated)
RoB	Rosebud loam, 1 to 3 percent slopes (where irrigated)
SnB	Satanta fine sandy loam, 0 to 3 percent slopes (where irrigated)
SnC	Satanta fine sandy loam, 3 to 6 percent slopes (where irrigated)
ThB	Thirtynine loam, 1 to 3 percent slopes (where irrigated)
ThC	Thirtynine loam, 3 to 6 percent slopes (where irrigated)
TwB	Tuthill fine sandy loam, 0 to 3 percent slopes (where irrigated)
TwC	Tuthill fine sandy loam, 3 to 6 percent slopes (where irrigated)
Vt	Vetal fine sandy loam, 0 to 2 percent slopes (where irrigated)

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS

(Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability N	Land capability I	Corn N	Corn I	Winter wheat N	Winter wheat I	Alfalfa hay N	Alfalfa hay I	Beans, other dry N	Beans, other dry I
			Bu	Bu	Bu	Bu	Tons	Tons	Bu	Bu
Ac----------------- Alliance	IIc	I	---	150	43	---	1.8	5.6	---	38
AcB---------------- Alliance	IIe	IIe	---	145	39	---	1.6	5.2	---	34
AcC---------------- Alliance	IIIe	IIIe	---	130	34	---	1.3	4.7	---	32
An----------------- Almeria	VIw	---	---	---	---	---	---	---	---	---
Bc----------------- Bankard	VIw	---	---	---	---	---	---	---	---	---
Bd----------------- Beckton	IVs	IVs	---	---	---	---	---	---	---	---
Bf----------------- Bolent	IVw	IVw	---	80	---	---	1.4	3.4	---	---
Bh----------------- Bridget	IIc	IIe	---	145	40	---	1.5	5.0	---	---
BhB---------------- Bridget	IIe	IIe	---	140	39	---	1.4	4.6	---	---
Bm----------------- Bridget	IIc	I	---	150	40	---	1.6	5.2	---	35
BnB---------------- Bufton	IIIe	IIIe	---	100	30	---	1.5	3.8	---	---
BnE---------------- Bufton	VIe	---	---	---	---	---	---	---	---	---
BoD:										
Bufton-------------	IVe	IVe	---	80	25	---	1.3	3.4	---	---
Orella-------------	VIs	---	---	---	---	---	---	---	---	---
BsB---------------- Busher	IIIe	IIe	---	115	34	---	1.2	4.6	---	30
BsC---------------- Busher	IIIe	IIIe	---	110	32	---	1.0	4.0	---	26
BsD---------------- Busher	IVe	IVe	---	75	25	---	0.8	3.6	---	---
BvC:										
Busher-------------	IIIe	IIIe	---	110	32	---	1.0	4.0	---	---
Tassel-------------	VIs	---	---	---	---	---	---	---	---	---

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability		Corn		Winter wheat		Alfalfa hay		Beans, other dry	
	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Bu	Bu	Tons	Tons	Bu	Bu
BvF:										
Busher	VIe	---	---	---	---	---	---	---	---	---
Tassel	VIs	---	---	---	---	---	---	---	---	---
Ca Calamus	VIe	IVe	---	100	26	---	1.4	3.8	---	---
Cr, Cs Crowther	Vw	---	---	---	---	---	---	---	---	---
DuB Dailey	IVe	IVe	---	100	---	---	1.5	4.0	---	28
DuD Dailey	VIe	IVe	---	95	---	---	1.0	3.5	---	26
Dw Duroc	IIc	I	---	150	45	---	2.0	6.0	---	40
DwB Duroc	IIe	IIe	---	145	42	---	1.8	5.4	---	38
Ec Els	VIe	IVw	---	85	---	---	1.4	2.8	---	---
Ef:										
Els	VIe	IVw	---	---	---	---	---	---	---	---
Hoffland	Vw	---	---	---	---	---	---	---	---	---
EgB:										
Els	VIe	IVw	---	85	---	---	1.4	2.8	---	---
Ipage	VIe	IVe	---	100	---	---	1.2	3.6	---	---
En:										
Els	VIe	IVw	---	---	---	---	---	---	---	---
Tryon	Vw	---	---	---	---	---	---	---	---	---
Es Elsmere	IVw	IVw	---	90	---	---	1.7	3.5	---	---
EuE:										
Enning	VIs	---	---	---	---	---	---	---	---	---
Minnequa	VIe	---	---	---	---	---	---	---	---	---
EvG*:										
Enning	VIIs	---	---	---	---	---	---	---	---	---
Rock outcrop	VIIIs	---	---	---	---	---	---	---	---	---
EwG:										
Epping	VIIs	---	---	---	---	---	---	---	---	---
Badland	VIIIs	---	---	---	---	---	---	---	---	---
Fu Fluvaquents	VIIIw	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability		Corn		Winter wheat		Alfalfa hay		Beans, other dry	
	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Bu	Bu	Tons	Tons	Bu	Bu
Gg, Gh. Gannett	Vw	---	---	---	---	---	---	---	---	---
Hm, Hn. Hoffland	Vw	---	---	---	---	---	---	---	---	---
IpB. Ipage	VIe	IVe	---	100	---	---	1.2	3.6	---	---
JgB. Jayem	IIIe	IIe	---	125	38	---	1.3	4.9	---	33
JgC. Jayem	IVe	IIIe	---	110	32	---	1.1	4.3	---	28
JgD. Jayem	IVe	IVe	---	100	29	---	1.0	4.1	---	---
Jo. Johnstown	IIc	I	---	150	44	---	1.8	5.6	---	38
Kd. Kadoka	IIc	I	---	150	43	---	1.8	5.6	---	---
KdC. Kadoka	IIIe	IIIe	---	125	34	---	1.3	4.7	---	---
KdD. Kadoka	IVe	IVe	---	115	33	---	1.0	4.3	---	---
Ke. Keith	IIc	I	---	150	44	---	1.8	5.6	---	38
KeB. Keith	IIe	IIe	---	145	40	---	1.6	5.2	---	34
KeC. Keith	IIIe	IIIe	---	130	34	---	1.3	4.7	---	32
Kg. Keith	IIc	I	---	150	44	---	1.8	5.6	---	38
KgB. Keith	IIe	IIe	---	145	40	---	1.6	5.2	---	34
KgC. Keith	IIIe	IIIe	---	125	34	---	1.3	4.7	---	30
Ky. Keya	IIc	I	---	150	43	---	2.0	5.6	---	36
La. Las Animas	IIw	IIw	---	100	26	---	1.8	4.1	---	30
Lg. Lodgepole	IIIw	IVw	---	90	20	---	2.0	3.8	---	25
Lu. Lute	VIs	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability		Corn		Winter wheat		Alfalfa hay		Beans, other dry	
	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Bu	Bu	Tons	Tons	Bu	Bu
MbC----------------- Manvel	IVe	IVe	---	---	---	---	0.9	4.0	---	---
Mc------------------ Marlake	VIIIw	---	---	---	---	---	---	---	---	---
Mk------------------ McCook	IIc	I	---	150	42	---	2.0	5.6	---	37
Mm------------------ McCook	VIw	---	---	---	---	---	---	---	---	---
MxF:										
Mitchell-----------	VIe	---	---	---	---	---	---	---	---	---
Epping-------------	VIs	---	---	---	---	---	---	---	---	---
My------------------ Munjor	IIIe	IIe	---	100	25	---	1.8	4.5	---	---
Mz------------------ Munjor	VIw	---	---	---	---	---	---	---	---	---
OhC:										
Oglala-------------	IIIe	IIIe	---	105	30	---	1.0	3.9	---	---
Canyon-------------	VIs	---	---	---	---	---	---	---	---	---
OhD:										
Oglala-------------	IVe	IVe	---	---	26	---	0.8	3.6	---	---
Canyon-------------	VIs	---	---	---	---	---	---	---	---	---
OhF:										
Oglala-------------	VIe	---	---	---	---	---	---	---	---	---
Canyon-------------	VIs	---	---	---	---	---	---	---	---	---
On------------------ Onita	IIs	IIs	---	140	43	---	1.8	5.6	---	38
OrF----------------- Orella	VIs	---	---	---	---	---	---	---	---	---
OvD----------------- Orpha	VIe	IVe	---	---	---	---	---	2.5	---	---
OwF:										
Orpha--------------	VIe	---	---	---	---	---	---	---	---	---
Niobrara-----------	VIs	---	---	---	---	---	---	---	---	---
OxG*:										
Orpha--------------	VIIe	---	---	---	---	---	---	---	---	---
Rock outcrop-------	VIIIs	---	---	---	---	---	---	---	---	---
PoC----------------- Ponderosa	IIIe	IIIe	---	---	32	---	1.2	4.2	---	---

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability N	Land capability I	Corn N	Corn I	Winter wheat N	Winter wheat I	Alfalfa hay N	Alfalfa hay I	Beans, other dry N	Beans, other dry I
			Bu	Bu	Bu	Bu	Tons	Tons	Bu	Bu
PoD----------------- Ponderosa	IVe	IVe	---	---	27	---	1.0	4.0	---	---
PtF*:										
Ponderosa----------	VIe	---	---	---	---	---	---	---	---	---
Tassel-------------	VIs	---	---	---	---	---	---	---	---	---
Vetal--------------	VIe	---	---	---	---	---	---	---	---	---
RoB----------------- Rosebud	IIIe	IIIe	---	130	36	---	1.3	4.8	---	30
SnB----------------- Satanta	IIIe	IIe	---	140	40	---	1.7	5.3	---	34
SnC----------------- Satanta	IIIe	IIIe	---	130	34	---	1.3	4.8	---	30
SnD----------------- Satanta	IVe	IVe	---	120	28	---	1.0	4.1	---	---
SsD:										
Satanta------------	IVe	IVe	---	---	---	---	---	---	---	---
Canyon-------------	VIs	---	---	---	---	---	---	---	---	---
SsE:										
Satanta------------	VIe	---	---	---	---	---	---	---	---	---
Canyon-------------	VIs	---	---	---	---	---	---	---	---	---
TfG*:										
Tassel-------------	VIIs	---	---	---	---	---	---	---	---	---
Rock outcrop-------	VIIIs	---	---	---	---	---	---	---	---	---
TgG*:										
Tassel-------------	VIIs	---	---	---	---	---	---	---	---	---
Ponderosa----------	VIe	---	---	---	---	---	---	---	---	---
Rock outcrop-------	VIIIs	---	---	---	---	---	---	---	---	---
ThB----------------- Thirtynine	IIe	IIe	---	145	40	---	1.6	5.2	---	---
ThC----------------- Thirtynine	IIIe	IIIe	---	130	34	---	1.3	4.7	---	---
ThD----------------- Thirtynine	IVe	IVe	---	120	33	---	1.0	4.3	---	---
To, Tp-------------- Tryon	Vw	---	---	---	---	---	---	---	---	---
TtB----------------- Tuthill	IVe	IIIe	---	115	25	---	1.0	4.0	---	---
TtD----------------- Tuthill	VIe	IVe	---	90	---	---	---	3.8	---	---

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability N	Land capability I	Corn N	Corn I	Winter wheat N	Winter wheat I	Alfalfa hay N	Alfalfa hay I	Beans, other dry N	Beans, other dry I
			Bu	Bu	Bu	Bu	Tons	Tons	Bu	Bu
TwB----------------- Tuthill	IIIe	IIe	---	120	33	---	1.4	4.3	---	---
TwC----------------- Tuthill	IIIe	IIIe	---	115	31	---	1.3	4.0	---	---
TwD----------------- Tuthill	IVe	IVe	---	95	26	---	1.1	3.2	---	---
VaB----------------- Valent	VIe	IVe	---	90	---	---	---	3.2	---	---
VaD----------------- Valent	VIe	IVe	---	80	---	---	---	3.0	---	---
VaE----------------- Valent	VIe	---	---	---	---	---	---	---	---	---
VaF:										
Valent, rolling----	VIe	---	---	---	---	---	---	---	---	---
Valent, hilly------	VIIe	---	---	---	---	---	---	---	---	---
VaG----------------- Valent	VIIe	---	---	---	---	---	---	---	---	---
VeB----------------- Valent	VIe	IVe	---	100	---	---	---	3.5	---	---
VeD----------------- Valent	VIe	IVe	---	95	---	---	---	3.4	---	---
VnD----------------- Valentine	VIe	IVe	---	80	---	---	---	3.2	---	---
VnE----------------- Valentine	VIe	---	---	---	---	---	---	---	---	---
VnF:										
Valentine, rolling-	VIe	---	---	---	---	---	---	---	---	---
Valentine, hilly---	VIIe	---	---	---	---	---	---	---	---	---
VnG----------------- Valentine	VIIe	---	---	---	---	---	---	---	---	---
VsB----------------- Vetal	IIIe	IIIe	---	120	36	---	1.3	4.8	---	32
Vt------------------ Vetal	IIe	IIe	---	140	37	---	1.4	5.0	---	34
WrB----------------- Wildhorse	VIs	---	---	---	---	---	---	---	---	---
WsB:										
Wildhorse----------	VIs	---	---	---	---	---	---	---	---	---
Hoffland-----------	Vw	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability		Corn		Winter wheat		Alfalfa hay		Beans, other dry	
	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Bu	Bu	Tons	Tons	Bu	Bu
WtB:										
Wildhorse----------	VIs	---	---	---	---	---	---	---	---	---
Ipage--------------	VIe	IVe	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

(All soils are assigned to nonirrigated capability subclasses (N). Only potentially irrigable soils are assigned to irrigated subclasses (I). Miscellaneous areas are excluded. Absence of an entry indicates no acreage)

Class	Total acreage	Major management concerns (Subclass)			
		Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
		Acres	Acres	Acres	Acres
I (N)	---	---	---	---	---
(I)	68,740	---	---	---	---
II (N)	119,230	45,820	1,020	460	71,930
(I)	114,310	112,830	1,020	460	---
III (N)	164,442	163,152	1,290	---	---
(I)	112,542	112,542	---	---	---
IV (N)	157,556	136,126	5,220	16,210	---
(I)	411,245	371,388	23,647	16,210	---
V (N)	28,017	---	28,017	---	---
VI (N)	834,168	695,395	8,970	129,803	---
VII (N)	232,773	183,606	---	49,167	---
VIII(N)	32,241	---	6,880	25,361	---

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

(Only the soils that support rangeland vegetation suitable for grazing are listed)

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Ac, AcB, AcC Alliance	Silty - Veg. Zone 2	Favorable	3,300	Western wheatgrass	20
		Normal	2,500	Blue grama	15
		Unfavorable	1,700	Needleandthread	15
				Little bluestem	10
				Buffalograss	5
				Sedge	5
				Green needlegrass	5
				Big bluestem	5
An Almeria	Wetland - Veg. Zone 2	Favorable	5,500	Prairie cordgrass	30
		Normal	5,000	Northern reedgrass	15
		Unfavorable	4,500	Sedge	15
				Bluejoint reedgrass	15
				Rush	10
				Slender wheatgrass	5
Bc Bankard	Sandy Lowland - Veg. Zone 2	Favorable	900	Blue grama	30
		Normal	700	Needleandthread	10
		Unfavorable	400	Fendler threeawn	10
				Prairie sandreed	5
				Sand bluestem	5
				Sand dropseed	5
				Sedge	5
				Little bluestem	5
				Buffalograss	5
Bd Beckton	Saline Lowland - Veg. Zone 2	Favorable	2,500	Alkali sacaton	25
		Normal	1,800	Western wheatgrass	15
		Unfavorable	1,000	Blue grama	10
				Sedge	10
				Slender wheatgrass	10
				Inland saltgrass	10
				Buffalograss	5
Bf Bolent	Subirrigated - Veg. Zone 2	Favorable	5,500	Big bluestem	30
		Normal	5,000	Indiangrass	15
		Unfavorable	4,200	Little bluestem	15
				Prairie cordgrass	10
				Switchgrass	10
				Sedge	5
Bh, BhB, Bm Bridget	Silty - Veg. Zone 2	Favorable	3,300	Needleandthread	20
		Normal	2,500	Blue grama	15
		Unfavorable	1,700	Western wheatgrass	15
				Threadleaf sedge	10
				Little bluestem	10
				Big bluestem	10
				Buffalograss	5
				Sideoats grama	5
BnB, BnE Bufton	Clayey - Veg. Zone 2	Favorable	2,000	Western wheatgrass	50
		Normal	1,700	Blue grama	15
		Unfavorable	1,100	Threadleaf sedge	10
				Green needlegrass	10
				Buffalograss	5

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
BoD*:					
Bufton	Clayey - Veg. Zone 2	Favorable	2,000	Western wheatgrass	50
		Normal	1,700	Blue grama	15
		Unfavorable	1,100	Threadleaf sedge	10
				Green needlegrass	10
				Buffalograss	5
Orella	Saline Upland - Veg. Zone 2	Favorable	1,000	Western wheatgrass	40
		Normal	700	Blue grama	20
		Unfavorable	400	Buffalograss	10
				Green needlegrass	10
				Sandberg bluegrass	5
				Common pricklypear	5
BsB, BsC, BsD Busher	Sandy - Veg. Zone 2	Favorable	3,000	Prairie sandreed	25
		Normal	2,300	Sand bluestem	20
		Unfavorable	1,700	Little bluestem	20
				Needleandthread	10
				Blue grama	10
				Threadleaf sedge	5
BvC*, BvF*:					
Busher	Sandy - Veg. Zone 2	Favorable	3,000	Prairie sandreed	25
		Normal	2,300	Sand bluestem	20
		Unfavorable	1,700	Little bluestem	20
				Needleandthread	10
				Blue grama	10
				Threadleaf sedge	5
Tassel	Shallow Limy - Veg. Zone 2	Favorable	1,500	Little bluestem	20
		Normal	1,100	Blue grama	20
		Unfavorable	700	Needleandthread	15
				Sand bluestem	10
				Western wheatgrass	10
				Sideoats grama	10
				Threadleaf sedge	5
Ca Calamus	Sandy - Veg. Zone 2	Favorable	2,600	Sand bluestem	25
		Normal	2,200	Prairie sandreed	20
		Unfavorable	1,600	Little bluestem	15
				Needleandthread	10
				Blue grama	10
				Switchgrass	5
				Sedge	5
				Indiangrass	5
Cr Crowther	Wet Subirrigated - Veg. Zone 2.	Favorable	5,300	Big bluestem	20
		Normal	4,800	Switchgrass	15
		Unfavorable	4,300	Prairie cordgrass	15
				Indiangrass	10
				Slender wheatgrass	5
				Plains bluegrass	5
Cs Crowther	Wetland - Veg. Zone 2	Favorable	5,500	Prairie cordgrass	30
		Normal	5,000	Northern reedgrass	15
		Unfavorable	4,500	Bluejoint reedgrass	15
				Slender wheatgrass	10
				Rush	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
DuB, DuD: Dailey	Sandy - Veg. Zone 2	Favorable	3,000	Prairie sandreed	30
		Normal	2,300	Sand bluestem	20
		Unfavorable	1,700	Little bluestem	15
				Needleandthread	15
				Blue grama	10
Dw: Duroc	Silty Lowland - Veg. Zone 2	Favorable	3,800	Western wheatgrass	20
		Normal	3,000	Needleandthread	15
		Unfavorable	2,300	Big bluestem	10
				Blue grama	10
				Little bluestem	10
				Prairie junegrass	5
				Threadleaf sedge	5
				Buffalograss	5
DwB: Duroc	Silty - Veg. Zone 2	Favorable	3,300	Big bluestem	15
		Normal	2,500	Needleandthread	15
		Unfavorable	1,700	Western wheatgrass	15
				Blue grama	10
				Green needlegrass	10
				Little bluestem	10
				Threadleaf sedge	10
				Buffalograss	5
Ec: Els	Subirrigated - Veg. Zone 2	Favorable	4,800	Little bluestem	25
		Normal	4,600	Indiangrass	20
		Unfavorable	4,300	Switchgrass	15
				Big bluestem	10
				Plains bluegrass	5
				Slender wheatgrass	5
				Sedge	5
Ef*:					
Els	Subirrigated - Veg. Zone 2	Favorable	4,800	Little bluestem	25
		Normal	4,600	Indiangrass	20
		Unfavorable	4,300	Switchgrass	15
				Big bluestem	10
				Plains bluegrass	5
				Slender wheatgrass	5
				Sedge	5
Hoffland	Wet Subirrigated - Veg. Zone 2	Favorable	5,300	Big bluestem	20
		Normal	4,800	Switchgrass	15
		Unfavorable	4,300	Prairie cordgrass	15
				Indiangrass	10
				Slender wheatgrass	5
				Plains bluegrass	5
EgB*:					
Els	Subirrigated - Veg. Zone 2	Favorable	4,800	Little bluestem	25
		Normal	4,600	Indiangrass	20
		Unfavorable	4,300	Switchgrass	15
				Big bluestem	10
				Plains bluegrass	5
				Slender wheatgrass	5
				Sedge	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
EgB*:					
Ipage	Sandy Lowland - Veg. Zone 2	Favorable	3,500	Sand bluestem	25
		Normal	3,200	Little bluestem	20
		Unfavorable	3,000	Prairie sandreed	15
				Needleandthread	10
				Indiangrass	5
				Sedge	5
				Switchgrass	5
				Blue grama	5
En*:					
Els	Subirrigated - Veg. Zone 2	Favorable	4,800	Little bluestem	25
		Normal	4,600	Indiangrass	20
		Unfavorable	4,300	Switchgrass	15
				Big bluestem	10
				Plains bluegrass	5
				Slender wheatgrass	5
				Sedge	5
Tryon	Wet Subirrigated - Veg. Zone 2	Favorable	5,300	Big bluestem	20
		Normal	5,000	Switchgrass	15
		Unfavorable	4,700	Prairie cordgrass	15
				Indiangrass	10
				Slender wheatgrass	5
				Plains bluegrass	5
Es Elsmere	Subirrigated - Veg. Zone 2	Favorable	5,000	Big bluestem	25
		Normal	4,800	Little bluestem	20
		Unfavorable	4,500	Switchgrass	10
				Indiangrass	10
				Prairie cordgrass	10
				Sedge	5
				Plains bluegrass	5
				Slender wheatgrass	5
EuE*:					
Enning	Shallow Limy - Veg. Zone 2	Favorable	1,900	Little bluestem	30
		Normal	1,600	Sideoats grama	25
		Unfavorable	1,100	Blue grama	15
				Needleandthread	10
				Sedge	10
Minnequa	Limy Upland - Veg. Zone 2	Favorable	2,000	Blue grama	20
		Normal	1,700	Big bluestem	20
		Unfavorable	1,500	Western wheatgrass	10
				Needlegrass	10
				Sedge	10
				Sideoats grama	10
				Little bluestem	5
EvG*:					
Enning	Shallow Limy - Veg. Zone 2	Favorable	1,900	Little bluestem	30
		Normal	1,600	Sideoats grama	25
		Unfavorable	1,100	Blue grama	15
				Needleandthread	10
				Sedge	10
Rock outcrop.					

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
EwG*:					
Epping	Shallow Limy - Veg. Zone 2	Favorable	1,500	Little bluestem	20
		Normal	1,100	Blue grama	15
		Unfavorable	700	Needleandthread	10
				Sideoats grama	10
				Western wheatgrass	10
				Threadleaf sedge	5
				Buffalograss	5
				Prairie sandreed	5
Badland.					
Gg	Wet Subirrigated - Veg. Zone 2	Favorable	5,300	Prairie cordgrass	20
Gannett		Normal	5,000	Big bluestem	20
		Unfavorable	4,700	Switchgrass	15
				Indiangrass	10
				Northern reedgrass	5
				Slender wheatgrass	5
				Plains bluegrass	5
Gh	Wetland - Veg. Zone 2	Favorable	5,500	Prairie cordgrass	35
Gannett		Normal	5,300	Northern reedgrass	15
		Unfavorable	5,200	Bluejoint reedgrass	10
				Slender wheatgrass	10
				Plains bluegrass	5
Hm	Wet Subirrigated - Veg. Zone 2	Favorable	5,300	Big bluestem	20
Hoffland		Normal	4,800	Switchgrass	15
		Unfavorable	4,300	Prairie cordgrass	15
				Indiangrass	10
				Slender wheatgrass	5
				Plains bluegrass	5
Hn	Wetland - Veg. Zone 2	Favorable	5,500	Prairie cordgrass	30
Hoffland		Normal	5,000	Northern reedgrass	15
		Unfavorable	4,500	Bluejoint reedgrass	15
				Slender wheatgrass	10
				Rush	5
IpB	Sandy Lowland - Veg. Zone 2	Favorable	3,500	Sand bluestem	25
Ipage		Normal	3,200	Little bluestem	20
		Unfavorable	3,000	Prairie sandreed	15
				Needleandthread	10
				Indiangrass	5
				Sedge	5
				Switchgrass	5
				Blue grama	5
JgB, JgC, JgD	Sandy - Veg. Zone 2	Favorable	3,000	Prairie sandreed	20
Jayem		Normal	2,300	Little bluestem	15
		Unfavorable	1,600	Needleandthread	15
				Sand bluestem	15
				Blue grama	10
				Fringed sagebrush	5
				Sand dropseed	5
				Threadleaf sedge	5
				Western wheatgrass	5
				Switchgrass	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Jo: Johnstown	Silty - Veg. Zone 2	Favorable	3,800	Big bluestem	20
		Normal	3,500	Little bluestem	15
		Unfavorable	3,000	Sideoats grama	10
				Blue grama	10
				Western wheatgrass	10
				Needleandthread	10
				Switchgrass	5
				Indiangrass	5
Kd, KdC, KdD: Kadoka	Silty - Veg. Zone 2	Favorable	3,300	Western wheatgrass	20
		Normal	2,500	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
				Big bluestem	10
				Little bluestem	10
				Sideoats grama	10
Ke, KeB, KeC: Keith	Silty - Veg. Zone 2	Favorable	3,300	Blue grama	20
		Normal	2,500	Needleandthread	20
		Unfavorable	1,700	Western wheatgrass	15
				Little bluestem	10
				Buffalograss	5
				Sedge	5
				Big bluestem	5
				Sideoats grama	5
				Green needlegrass	5
Kg, KgB, KgC: Keith	Silty - Veg. Zone 2	Favorable	3,300	Blue grama	20
		Normal	2,500	Needleandthread	20
		Unfavorable	1,700	Little bluestem	15
				Western wheatgrass	15
				Big bluestem	10
				Green needlegrass	5
				Sideoats grama	5
Ky: Keya	Silty - Veg. Zone 2	Favorable	3,700	Green needlegrass	40
		Normal	3,200	Western wheatgrass	15
		Unfavorable	2,200	Big bluestem	10
				Needleandthread	10
				Sideoats grama	10
				Blue grama	5
				Little bluestem	5
La: Las Animas	Subirrigated - Veg. Zone 2	Favorable	5,000	Little bluestem	20
		Normal	4,500	Big bluestem	15
		Unfavorable	3,250	Indiangrass	10
				Sedge	10
				Prairie cordgrass	10
				Switchgrass	5
				Kentucky bluegrass	5
				Western wheatgrass	5
				Slender wheatgrass	5
				Plains bluegrass	5
Lg: Lodgepole	Clayey Overflow - Veg. Zone 2	Favorable	1,200	Western wheatgrass	40
		Normal	1,000	Blue grama	15
		Unfavorable	700	Green needlegrass	15
				Buffalograss	10
				Sedge	10

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Lu----------------- Lute	Saline Subirrigated - Veg. Zone 2.	Favorable	3,300	Cordgrass	35
		Normal	3,000	Western wheatgrass	30
		Unfavorable	2,400	Inland saltgrass	25
MbC---------------- Manvel	Limy Upland - Veg. Zone 2	Favorable	1,800	Blue grama	25
		Normal	1,500	Needlegrass	25
		Unfavorable	1,000	Sedge	20
				Western wheatgrass	15
Mk----------------- McCook	Silty Lowland - Veg. Zone 2	Favorable	3,800	Western wheatgrass	20
		Normal	2,800	Big bluestem	15
		Unfavorable	2,300	Needleandthread	15
				Little bluestem	10
				Blue grama	10
				Sideoats grama	10
				Sedge	5
				Switchgrass	5
Mm----------------- McCook	Silty Overflow - Veg. Zone 2	Favorable	3,000	Western wheatgrass	30
		Normal	2,800	Big bluestem	15
		Unfavorable	2,500	Little bluestem	15
				Blue grama	10
				Sideoats grama	10
				Sedge	5
MxF*:					
Mitchell	Limy Upland - Veg. Zone 2	Favorable	2,800	Little bluestem	20
		Normal	2,000	Blue grama	15
		Unfavorable	1,500	Needleandthread	15
				Sideoats grama	10
				Big bluestem	10
				Threadleaf sedge	5
				Western wheatgrass	5
				Prairie sandreed	5
Epping	Shallow Limy - Veg. Zone 2	Favorable	1,000	Blue grama	20
		Normal	700	Needleandthread	15
		Unfavorable	500	Threadleaf sedge	10
				Sideoats grama	10
				Western wheatgrass	10
				Little bluestem	10
				Buffalograss	5
				Prairie sandreed	5
My----------------- Munjor	Sandy Lowland - Veg. Zone 2	Favorable	3,000	Prairie sandreed	20
		Normal	2,300	Sand bluestem	15
		Unfavorable	1,700	Little bluestem	15
				Needleandthread	10
				Blue grama	10
				Sand dropseed	5
				Switchgrass	5
				Scribner panicum	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Mz: Munjor	Sandy Lowland - Veg. Zone 2	Favorable	3,000	Prairie sandreed	20
		Normal	2,300	Sand bluestem	15
		Unfavorable	1,700	Little bluestem	15
				Needleandthread	10
				Blue grama	10
				Sand dropseed	5
				Sedge	5
				Switchgrass	5
				Scribner panicum	5
OhC*, OhD*, OhF*:					
Oglala	Silty - Veg. Zone 2	Favorable	3,300	Western wheatgrass	20
		Normal	2,500	Blue grama	15
		Unfavorable	1,700	Little bluestem	15
				Needleandthread	15
				Green needlegrass	10
				Big bluestem	5
				Sideoats grama	5
				Sedge	5
Canyon	Shallow Limy - Veg. Zone 2	Favorable	1,000	Blue grama	25
		Normal	700	Little bluestem	15
		Unfavorable	500	Western wheatgrass	15
				Threadleaf sedge	10
				Needleandthread	10
				Sideoats grama	5
				Sand bluestem	5
				Bluegrass	5
On: Onita	Clayey - Veg. Zone 2	Favorable	3,000	Western wheatgrass	35
		Normal	2,100	Blue grama	15
		Unfavorable	1,200	Green needlegrass	10
				Sedge	10
				Big bluestem	5
				Sideoats grama	5
				Buffalograss	5
OrF: Orella	Saline Upland - Veg. Zone 2	Favorable	1,000	Western wheatgrass	40
		Normal	700	Blue grama	20
		Unfavorable	400	Buffalograss	10
				Green needlegrass	10
				Sandberg bluegrass	5
				Common pricklypear	5
OvD: Orpha	Sands - Veg. Zone 2	Favorable	3,000	Prairie sandreed	30
		Normal	2,300	Sand bluestem	20
		Unfavorable	1,700	Little bluestem	15
				Needleandthread	15
				Sedge	10
				Blue grama	5
				Switchgrass	5
OwF*:					
Orpha	Sands - Veg. Zone 2	Favorable	3,000	Prairie sandreed	30
		Normal	2,300	Sand bluestem	20
		Unfavorable	1,700	Little bluestem	15
				Needleandthread	15
				Sedge	10
				Blue grama	5
				Switchgrass	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
OwF*:					
Niobrara	Shallow Limy - Veg. Zone 2	Favorable	1,000	Blue grama	25
		Normal	700	Little bluestem	15
		Unfavorable	500	Sideoats grama	10
				Needleandthread	10
				Western wheatgrass	10
				Threadleaf sedge	10
OxG*:					
Orpha	Sands - Veg. Zone 2	Favorable	3,000	Prairie sandreed	30
		Normal	2,300	Sand bluestem	20
		Unfavorable	1,700	Little bluestem	15
				Needleandthread	15
				Sedge	10
				Blue grama	5
				Switchgrass	5
Rock outcrop.					
PoC, PoD Ponderosa	Sandy - Veg. Zone 2	Favorable	3,000	Little bluestem	20
		Normal	2,300	Prairie sandreed	20
		Unfavorable	1,700	Needleandthread	15
				Blue grama	10
				Sand bluestem	10
				Green needlegrass	5
				Sedge	5
PtF*:					
Ponderosa	Sandy - Veg. Zone 2	Favorable	3,000	Little bluestem	20
		Normal	2,300	Prairie sandreed	20
		Unfavorable	1,700	Needleandthread	15
				Blue grama	10
				Sand bluestem	10
				Green needlegrass	5
				Sedge	5
Tassel	Shallow Limy - Veg. Zone 2	Favorable	1,500	Little bluestem	20
		Normal	1,100	Blue grama	20
		Unfavorable	700	Needleandthread	15
				Sand bluestem	10
				Western wheatgrass	10
				Sideoats grama	10
				Threadleaf sedge	5
Vetal	Sandy - Veg. Zone 2	Favorable	3,000	Little bluestem	25
		Normal	2,300	Prairie sandreed	20
		Unfavorable	1,700	Needleandthread	10
				Sand bluestem	10
				Blue grama	10
				Western wheatgrass	5
				Switchgrass	5
RoB Rosebud	Silty - Veg. Zone 2	Favorable	3,300	Needleandthread	15
		Normal	2,500	Blue grama	15
		Unfavorable	1,700	Western wheatgrass	15
				Little bluestem	10
				Sideoats grama	10
				Green needlegrass	10
				Big bluestem	5
				Threadleaf sedge	5
				Buffalograss	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
SnB, SnC, SnD: Satanta	Silty - Veg. Zone 2	Favorable	3,200	Blue grama	20
		Normal	2,500	Western wheatgrass	20
		Unfavorable	1,800	Big bluestem	15
				Little bluestem	15
				Needleandthread	15
				Sideoats grama	10
SsD*, SsE*:					
Satanta	Silty - Veg. Zone 2	Favorable	3,200	Blue grama	20
		Normal	2,500	Western wheatgrass	20
		Unfavorable	1,800	Big bluestem	15
				Little bluestem	15
				Needleandthread	15
				Sideoats grama	10
Canyon	Shallow Limy - Veg. Zone 2	Favorable	1,500	Little bluestem	20
		Normal	1,100	Blue grama	20
		Unfavorable	700	Needleandthread	15
				Sideoats grama	10
				Sand bluestem	10
				Western wheatgrass	10
				Threadleaf sedge	5
TfG*:					
Tassel	Shallow Limy - Veg. Zone 2	Favorable	1,500	Little bluestem	20
		Normal	1,100	Blue grama	20
		Unfavorable	700	Needleandthread	15
				Sand bluestem	10
				Western wheatgrass	10
				Sideoats grama	10
				Threadleaf sedge	5
Rock outcrop.					
TgG*:					
Tassel	Shallow Limy - Veg. Zone 2	Favorable	1,500	Little bluestem	20
		Normal	1,100	Blue grama	20
		Unfavorable	700	Needleandthread	15
				Sand bluestem	10
				Western wheatgrass	10
				Sideoats grama	10
				Threadleaf sedge	5
Ponderosa	Savannah - Veg. Zone 2	Favorable	2,500	Little bluestem	15
		Normal	2,000	Prairie sandreed	15
		Unfavorable	1,500	Ponderosa pine	15
				Needleandthread	10
				Sideoats grama	10
				Blue grama	5
				Green needlegrass	5
				Sand bluestem	5
				Sedge	5
Rock outcrop.					

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
ThB, ThC, ThD------ Thirtynine	Silty - Veg. Zone 2-----------	Favorable	2,500	Western wheatgrass------------	25
		Normal	1,700	Blue grama--------------------	20
		Unfavorable	1,000	Needleandthread---------------	20
				Green needlegrass-------------	10
				Little bluestem---------------	5
				Sideoats grama----------------	5
				Sedge-------------------------	5
To----------------- Tryon	Wet Subirrigated - Veg. Zone 2	Favorable	5,300	Big bluestem------------------	20
		Normal	5,000	Switchgrass-------------------	15
		Unfavorable	4,700	Prairie cordgrass-------------	15
				Indiangrass-------------------	10
				Slender wheatgrass------------	5
				Plains bluegrass--------------	5
Tp----------------- Tryon	Wetland - Veg. Zone 2---------	Favorable	5,500	Prairie cordgrass-------------	30
		Normal	5,300	Northern reedgrass------------	15
		Unfavorable	5,000	Bluejoint reedgrass-----------	15
				Slender wheatgrass------------	10
				Rush--------------------------	5
TtB, TtD----------- Tuthill	Sandy - Veg. Zone 2-----------	Favorable	3,000	Prairie sandreed--------------	20
		Normal	2,300	Little bluestem---------------	15
		Unfavorable	1,700	Sand bluestem-----------------	15
				Needleandthread---------------	10
				Blue grama--------------------	10
				Western wheatgrass------------	5
				Threadleaf sedge--------------	5
				Sand dropseed-----------------	5
TwB, TwC, TwD------ Tuthill	Sandy - Veg. Zone 2-----------	Favorable	3,000	Prairie sandreed--------------	25
		Normal	2,500	Little bluestem---------------	20
		Unfavorable	1,700	Needleandthread---------------	20
				Sideoats grama----------------	10
				Big bluestem------------------	10
				Western wheatgrass------------	5
				Blue grama--------------------	5
VaB---------------- Valent	Sandy - Veg. Zone 2-----------	Favorable	2,600	Prairie sandreed--------------	20
		Normal	2,300	Sand bluestem-----------------	15
		Unfavorable	1,900	Little bluestem---------------	15
				Needleandthread---------------	15
				Blue grama--------------------	10
				Sand dropseed-----------------	5
				Threadleaf sedge--------------	5
VaD, VaE----------- Valent	Sands - Veg. Zone 2-----------	Favorable	3,000	Sand bluestem-----------------	25
		Normal	2,600	Prairie sandreed--------------	20
		Unfavorable	2,000	Little bluestem---------------	10
				Needleandthread---------------	10
				Switchgrass-------------------	10
				Blue grama--------------------	5
VaF*:					
Valent, rolling---	Sands - Veg. Zone 2-----------	Favorable	3,000	Sand bluestem-----------------	25
		Normal	2,600	Prairie sandreed--------------	20
		Unfavorable	2,000	Little bluestem---------------	10
				Needleandthread---------------	10
				Switchgrass-------------------	10
				Blue grama--------------------	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
VaF*:					
Valent, hilly	Choppy Sands - Veg. Zone 2	Favorable	2,800	Sand bluestem	30
		Normal	2,400	Prairie sandreed	20
		Unfavorable	1,800	Little bluestem	15
				Switchgrass	10
				Blue grama	5
				Needleandthread	5
VaG	Choppy Sands - Veg. Zone 2	Favorable	2,800	Sand bluestem	30
Valent		Normal	2,400	Prairie sandreed	20
		Unfavorable	1,800	Little bluestem	15
				Switchgrass	10
				Blue grama	5
				Needleandthread	5
VeB	Sandy - Veg. Zone 2	Favorable	2,600	Prairie sandreed	20
Valent		Normal	2,300	Sand bluestem	15
		Unfavorable	1,900	Little bluestem	15
				Needleandthread	15
				Blue grama	10
				Sand dropseed	5
				Threadleaf sedge	5
VeD	Sands - Veg. Zone 2	Favorable	3,000	Sand bluestem	25
Valent		Normal	2,600	Prairie sandreed	20
		Unfavorable	2,000	Little bluestem	10
				Needleandthread	10
				Switchgrass	10
				Blue grama	5
VnD, VnE	Sands - Veg. Zone 2	Favorable	3,000	Sand bluestem	25
Valentine		Normal	2,600	Little bluestem	20
		Unfavorable	2,200	Prairie sandreed	15
				Needleandthread	10
				Switchgrass	5
				Blue grama	5
				Sand lovegrass	5
VnF*:					
Valentine, rolling	Sands - Veg. Zone 2	Favorable	3,000	Sand bluestem	25
		Normal	2,600	Little bluestem	20
		Unfavorable	2,200	Prairie sandreed	15
				Needleandthread	10
				Switchgrass	5
				Blue grama	5
				Sand lovegrass	5
Valentine, hilly	Choppy Sands - Veg. Zone 2	Favorable	2,800	Little bluestem	25
		Normal	2,600	Sand bluestem	20
		Unfavorable	2,300	Prairie sandreed	15
				Switchgrass	10
				Needleandthread	5
				Sand lovegrass	5
				Sandhill muhly	5
VnG	Choppy Sands - Veg. Zone 2	Favorable	2,800	Little bluestem	25
Valentine		Normal	2,600	Sand bluestem	20
		Unfavorable	2,300	Prairie sandreed	15
				Switchgrass	10
				Needleandthread	5
				Sand lovegrass	5
				Sandhill muhly	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
VsB-----------------	Sandy - Veg. Zone 2-----------	Favorable	2,000	Needleandthread---------------	25
Vetal		Normal	1,500	Blue grama--------------------	25
		Unfavorable	800	Threadleaf sedge--------------	15
				Prairie sandreed--------------	10
				Western wheatgrass------------	10
				Sand dropseed-----------------	5
Vt------------------	Sandy - Veg. Zone 2-----------	Favorable	3,000	Little bluestem---------------	25
Vetal		Normal	2,300	Prairie sandreed--------------	20
		Unfavorable	1,700	Needleandthread---------------	10
				Sand bluestem-----------------	10
				Blue grama--------------------	10
				Western wheatgrass------------	5
				Switchgrass-------------------	5
WrB-----------------	Saline Subirrigated - Veg. Zone 2.	Favorable	3,200	Alkali sacaton----------------	35
Wildhorse		Normal	2,800	Inland saltgrass--------------	15
		Unfavorable	2,400	Western wheatgrass------------	10
				Switchgrass-------------------	5
				Alkali cordgrass--------------	5
				Slender wheatgrass------------	5
				Plains bluegrass--------------	5
				Sedge-------------------------	5
WsB*:					
Wildhorse-----------	Saline Subirrigated - Veg. Zone 2.	Favorable	3,200	Alkali sacaton----------------	35
		Normal	2,800	Inland saltgrass--------------	15
		Unfavorable	2,400	Western wheatgrass------------	10
				Switchgrass-------------------	5
				Alkali cordgrass--------------	5
				Slender wheatgrass------------	5
				Plains bluegrass--------------	5
				Sedge-------------------------	5
Hoffland------------	Wet Subirrigated - Veg. Zone 2.	Favorable	5,300	Big bluestem------------------	20
		Normal	4,800	Switchgrass-------------------	15
		Unfavorable	4,300	Prairie cordgrass-------------	15
				Indiangrass-------------------	10
				Slender wheatgrass------------	5
				Plains bluegrass--------------	5
WtB*:					
Wildhorse-----------	Saline Subirrigated - Veg. Zone 2.	Favorable	3,200	Alkali sacaton----------------	35
		Normal	2,800	Inland saltgrass--------------	15
		Unfavorable	2,400	Western wheatgrass------------	10
				Switchgrass-------------------	5
				Alkali cordgrass--------------	5
				Slender wheatgrass------------	5
				Plains bluegrass--------------	5
				Sedge-------------------------	5
Ipage---------------	Sandy Lowland - Veg. Zone 2---	Favorable	3,500	Sand bluestem-----------------	25
		Normal	3,200	Little bluestem---------------	20
		Unfavorable	3,000	Prairie sandreed--------------	15
				Needleandthread---------------	10
				Indiangrass-------------------	5
				Sedge-------------------------	5
				Switchgrass-------------------	5
				Blue grama--------------------	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--POTENTIAL PRODUCTIVITY FOR PONDEROSA PINE AND DEGREE OF LIMITATIONS OF WOODLAND SUITABILITY GROUPS

(The symbol > means more than; < means less than)

Woodland suitability group number and soil series	Potential productivity			Management concerns				
	Aspect	Site index	Approximate annual growth per acre at 80 years of age*	Erosion hazard	Seedling mortality	Plant competition	Equipment limitation	Windthrow hazard
Group 1------------- Ponderosa (moist)	North and east.	>70	>65	Moderate or severe	Slight----	Slight-----	Moderate or severe	Slight.
Group 2------------- Canyon and Tassel (moist)	North and east.	50-59	40	Severe----	Slight or moderate.	Moderate---	Severe----	Severe.
Group 3------------- Ponderosa (moist)	South and west.	40-49	30	Moderate or severe	Moderate or severe	Moderate---	Severe----	Severe.
Group 4------------- Canyon and Tassel	South and west.	<40	<25	Severe----	Severe----	Severe-----	Severe----	Severe.

* Annual growth is expressed in cubic feet. Divide by 90 to convert to approximate cords; multiply by 6 to convert to approximate board feet.

TABLE 10.--TREE PLANTING SITE PREPARATION GUIDE

Texture	Slope	Site preparation	
		Cropland	Grassland
Loamy or clayey	Level	Plant directly into site; do not destroy the existing crop residue; check for hardpan (see footnotes 1, 2, and 3).	Summer fallow the entire site 1 year prior to planting (see footnote 4); plant directly into site; do not destroy dead grass residue; check for hardpan (see footnotes 1 and 2).
Sandy	Level	Sow a cover crop late in summer if the soil will be bare over winter; plant directly into site or into cover crop; do not destroy the existing crop residue (see footnotes 2 and 3).	Summer fallow 4- to 8-foot strips 1 year prior to planting (see footnote 4); plant directly into the strips; do not destroy dead grass residue (see footnote 2).
Loamy or clayey	Sloping	Plant directly into site; do not destroy the existing crop residue (see footnotes 2 and 3); if possible, plant on the contour; check for hardpan.	Summer fallow the entire site 1 year prior to planting (see footnote 5); plant directly into site; do not destroy dead grass residue (see footnote 6); if possible, plant on the contour.
Sandy	Sloping	Sow a cover crop late in summer if the soil will be bare over winter; plant directly into site or into cover crop; do not destroy the existing crop residue (see footnotes 2 and 3); if possible, plant on the contour.	Summer fallow 4- to 8-foot strips 1 year prior to planting (see footnote 5); plant directly into the strips; do not destroy dead grass residue (see footnote 6); if possible, plant on the contour.

[1] The soil may have a hardpan as a result of farming, grazing, or soil geology, especially if the texture is loamy or clayey. Check for hardpan and deep chisel the subsoil during the fall prior to planting.

[2] Till the soil lightly or treat with labeled postemergence herbicide prior to planting if weeds are beginning to emerge.

[3] Check for herbicide carry-over via cooperator records or soil analysis. Avoid planting on cropland that has been treated with nonlabeled, residual herbicide during the prior growing season.

[4] Fallow either mechanically (tillage) or chemically (no-till) with labeled postemergence herbicide.

[5] Fallow chemically (no-till) with labeled postemergence herbicide.

[6] Treat with labeled postemergence herbicide prior to planting if weeds are beginning to emerge.

TABLE 11.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Ac, AcB, AcC: Alliance	Skunkbush sumac, lilac, Amur honeysuckle.	Rocky Mountain juniper.	Eastern redcedar, ponderosa pine, honeylocust, Russian-olive, bur oak, hackberry, green ash.	Siberian elm	---
An. Almeria					
Bc: Bankard	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---
Bd: Beckton	Eastern redcedar, Rocky Mountain juniper, Siberian peashrub, silver buffaloberry, lilac.	Siberian elm, green ash, ponderosa pine, Russian-olive.	---	---	---
Bf: Bolent	American plum, lilac, Siberian peashrub.	Manchurian crabapple.	Eastern redcedar, ponderosa pine, hackberry, green ash.	Golden willow, honeylocust.	Eastern cottonwood.
Bh, BhB, Bm: Bridget	Amur honeysuckle, lilac.	Rocky Mountain juniper, Russian-olive, common chokecherry, American plum.	Hackberry, ponderosa pine, green ash, eastern redcedar, honeylocust.	Siberian elm	---
BnB, BnE: Bufton	Siberian peashrub, lilac, American plum.	Eastern redcedar, Rocky Mountain juniper, ponderosa pine, green ash, Russian-olive, Manchurian crabapple.	Siberian elm, honeylocust.	---	---
BoD*:					
Bufton	Siberian peashrub, lilac, American plum.	Eastern redcedar, Rocky Mountain juniper, ponderosa pine, green ash, Russian-olive, Manchurian crabapple.	Siberian elm, honeylocust.	---	---
Orella.					

See footnote at end of table.

TABLE 11.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
BsB, BsC, BsD----- Busher	Lilac, American plum, Siberian peashrub, skunkbush sumac.	Eastern redcedar, Rocky Mountain juniper, Russian-olive.	Ponderosa pine, green ash, honeylocust, hackberry.	Siberian elm------	---
BvC*:					
Busher-----------	Lilac, American plum, Siberian peashrub, skunkbush sumac.	Eastern redcedar, Rocky Mountain juniper, Russian-olive.	Ponderosa pine, green ash, honeylocust, hackberry.	Siberian elm------	---
Tassel.					
BvF*:					
Busher.					
Tassel.					
Ca---------------- Calamus	---	Eastern redcedar, Rocky Mountain juniper.	Scotch pine, jack pine, ponderosa pine, Austrian pine.	---	---
Cr---------------- Crowther	Redosier dogwood	---	---	Golden willow-----	Eastern cottonwood.
Cs. Crowther					
DuB--------------- Dailey	Common chokecherry, American plum, lilac, Tatarian honeysuckle.	Rocky Mountain juniper, Siberian peashrub, Russian-olive, Manchurian crabapple.	Ponderosa pine, green ash, honeylocust.	Siberian elm------	---
DuD--------------- Dailey	American plum, lilac, Siberian peashrub, skunkbush sumac.	Rocky Mountain juniper, eastern redcedar, Russian-olive.	Ponderosa pine, green ash, honeylocust, hackberry.	Siberian elm------	---
Dw---------------- Duroc	Amur honeysuckle, lilac, American plum.	---	Rocky Mountain juniper, ponderosa pine, honeylocust, green ash, Russian-olive, eastern redcedar, hackberry.	Siberian elm------	Eastern cottonwood.
DwB--------------- Duroc	Lilac, American plum.	Rocky Mountain juniper, Siberian peashrub, skunkbush sumac, hackberry.	Ponderosa pine, honeylocust, eastern redcedar, Scotch pine, green ash.	Siberian elm------	---
Ec---------------- Els	Lilac, American plum, Siberian peashrub.	Manchurian crabapple.	Eastern redcedar, hackberry, ponderosa pine, green ash.	Golden willow, honeylocust.	Eastern cottonwood.

See footnote at end of table.

TABLE 11.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Ef*:					
Els	Lilac, American plum, Siberian peashrub.	Manchurian crabapple.	Eastern redcedar, hackberry, ponderosa pine, green ash.	Golden willow, honeylocust.	Eastern cottonwood.
Hoffland	Redosier dogwood	---	---	Golden willow	Eastern cottonwood.
EgB*:					
Els	Lilac, American plum, Siberian peashrub.	Manchurian crabapple.	Eastern redcedar, hackberry, ponderosa pine, green ash.	Golden willow, honeylocust.	Eastern cottonwood.
Ipage	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---
En*:					
Els	Lilac, American plum, Siberian peashrub.	Manchurian crabapple.	Eastern redcedar, hackberry, ponderosa pine, green ash.	Golden willow, honeylocust.	Eastern cottonwood.
Tryon	Redosier dogwood	---	---	Golden willow	Eastern cottonwood.
Es Elsmere	Lilac, American plum, Siberian peashrub.	Manchurian crabapple.	Eastern redcedar, ponderosa pine, hackberry, blue spruce, green ash.	Golden willow	Eastern cottonwood.
EuE*:					
Enning.					
Minnequa.					
EvG*:					
Enning.					
Rock outcrop.					
EwG*:					
Epping.					
Badland.					
Fu. Fluvaquents					
Gg Gannett	Redosier dogwood	---	---	Golden willow	Eastern cottonwood.
Gh. Gannett					
Hm Hoffland	Redosier dogwood	---	---	Golden willow	Eastern cottonwood.

See footnote at end of table.

TABLE 11.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Hn. Hoffland					
IpB. Ipage	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---
JgB, JgC, JgD. Jayem	Peking cotoneaster, Amur honeysuckle, Siberian peashrub, lilac.	Rocky Mountain juniper, eastern redcedar, Russian-olive, common chokecherry.	Green ash, ponderosa pine, Siberian elm, honeylocust.	---	---
Jo. Johnstown	Skunkbush sumac, Peking cotoneaster, American plum.	Eastern redcedar, Siberian peashrub.	Ponderosa pine, bur oak, Russian-olive, honeylocust, green ash, hackberry.	Siberian elm	---
Kd, KdC, KdD. Kadoka	Peking cotoneaster, skunkbush sumac, Siberian peashrub, lilac.	Eastern redcedar, Russian-olive, green ash, hackberry, Rocky Mountain juniper.	Siberian elm, ponderosa pine, honeylocust.	---	---
Ke, KeB, KeC. Keith	Lilac, American plum.	Rocky Mountain juniper, Manchurian crabapple, common chokecherry, Siberian peashrub.	Hackberry, ponderosa pine, green ash, honeylocust, Russian-olive.	Siberian elm	---
Kg, KgB, KgC. Keith	Peking cotoneaster, skunkbush sumac, American plum, Siberian peashrub.	Russian-olive, Rocky Mountain juniper.	Eastern redcedar, hackberry, green ash, ponderosa pine, honeylocust.	Siberian elm	---
Ky. Keya	---	Common chokecherry, Siberian peashrub, American plum, lilac.	Green ash, hackberry, Siberian crabapple, eastern redcedar.	Golden willow, ponderosa pine, blue spruce.	Eastern cottonwood.
La. Las Animas	Lilac, American plum.	Rocky Mountain juniper, Tatarian honeysuckle.	Eastern redcedar, green ash, ponderosa pine, hackberry, honeylocust.	Golden willow, Siberian elm.	Eastern cottonwood.
Lg. Lodgepole	Lilac, American plum, common chokecherry.	---	Eastern redcedar, ponderosa pine, honeylocust, hackberry, green ash, Russian mulberry.	Silver maple, golden willow.	---

See footnote at end of table.

TABLE 11.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Lu. Lute					
MbC Manvel	Siberian peashrub, fragrant sumac, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, Rocky Mountain juniper, ponderosa pine, black locust, green ash, Russian-olive.	Honeylocust, Siberian elm.	---	---
Mc. Marlake					
Mk McCook	American plum, lilac.	---	Eastern redcedar, ponderosa pine, hackberry, green ash, Russian-olive, Rocky Mountain juniper.	Honeylocust, Siberian elm.	Eastern cottonwood.
Mm. McCook					
MxF*: Mitchell.					
Epping.					
My Munjor	---	Siberian peashrub, silver buffaloberry.	Ponderosa pine, Russian-olive, green ash, Russian mulberry, eastern redcedar.	Siberian elm, hackberry, honeylocust.	Eastern cottonwood.
Mz. Munjor					
OhC*, OhD*: Oglala	American plum, lilac.	Manchurian crabapple, common chokecherry, Siberian peashrub.	Ponderosa pine, honeylocust, hackberry, Russian-olive, green ash, Rocky Mountain juniper.	Siberian elm	---
Canyon.					
OhF*: Oglala.					
Canyon.					
On Onita	Lilac	Siberian peashrub, American plum.	Ponderosa pine, blue spruce, green ash, hackberry, Russian mulberry, eastern redcedar.	Honeylocust	Eastern cottonwood.

See footnote at end of table.

TABLE 11.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
OrF. Orella					
OvD----------------- Orpha	---	Eastern redcedar, Austrian pine, Scotch pine, Rocky Mountain juniper, ponderosa pine, jack pine.	---	---	---
OwF*: Orpha.					
Niobrara.					
OxG*: Orpha.					
Rock outcrop.					
PoC, PoD---------- Ponderosa	Skunkbush sumac, lilac.	Eastern redcedar, Siberian peashrub, Rocky Mountain juniper, American plum.	Green ash, bur oak, hackberry, ponderosa pine, honeylocust.	Siberian elm------	---
PtF*: Ponderosa.					
Tassel.					
Vetal------------	Lilac-------------	Eastern redcedar, Rocky Mountain juniper, common chokecherry, Russian-olive, Siberian peashrub.	Hackberry, ponderosa pine, honeylocust, green ash.	Siberian elm------	---
RoB--------------- Rosebud	Skunkbush sumac, Siberian peashrub, lilac, Peking cotoneaster.	Eastern redcedar, Rocky Mountain juniper, Russian-olive, hackberry, green ash.	Ponderosa pine, Siberian elm, honeylocust.	---	---
SnB, SnC, SnD----- Satanta	Tatarian honeysuckle, American plum, Peking cotoneaster.	Eastern redcedar, common chokecherry, Rocky Mountain juniper.	Green ash, black locust, hackberry, Siberian elm, ponderosa pine, honeylocust.	---	---

See footnote at end of table.

TABLE 11.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
SsD*, SsE*:					
Satanta----------	Tatarian honeysuckle, American plum, Peking cotoneaster.	Eastern redcedar, common chokecherry, Rocky Mountain juniper.	Green ash, black locust, hackberry, Siberian elm, ponderosa pine, honeylocust.	---	---
Canyon.					
TfG*:					
Tassel.					
Rock outcrop.					
TgG*:					
Tassel.					
Ponderosa.					
Rock outcrop.					
ThB, ThC, ThD----- Thirtynine	American plum, Amur honeysuckle, lilac.	Russian-olive, Rocky Mountain juniper, common chokecherry.	Austrian pine, eastern redcedar, green ash, honeylocust, ponderosa pine, hackberry.	---	---
To---------------- Tryon	Redosier dogwood	---	---	Golden willow-----	Eastern cottonwood.
Tp. Tryon					
TtB, TtD---------- Tuthill	Amur honeysuckle, common chokecherry, Peking cotoneaster, American plum, Siberian peashrub.	Eastern redcedar, red mulberry, Rocky Mountain juniper, Russian-olive, Austrian pine.	Black locust, hackberry, green ash, Siberian elm, ponderosa pine, honeylocust.	---	---
TwB, TwC, TwD----- Tuthill	Peking cotoneaster, Siberian peashrub, lilac, skunkbush sumac.	Green ash, Rocky Mountain juniper, eastern redcedar, Russian-olive, hackberry.	Honeylocust, ponderosa pine, Siberian elm.	---	---
VaB, VaD, VaE----- Valent	---	Eastern redcedar, Rocky Mountain juniper, Austrian pine, jack pine.	Ponderosa pine----	---	---
VaF*:					
Valent, rolling--	---	Eastern redcedar, Rocky Mountain juniper, Austrian pine, jack pine.	Ponderosa pine----	---	---

See footnote at end of table.

TABLE 11.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
VaF*: Valent, hilly.					
VaG. Valent					
VeB, VeD---------- Valent	---	Eastern redcedar, Rocky Mountain juniper, Austrian pine, jack pine.	Ponderosa pine----	---	---
VnD, VnE---------- Valentine	---	Eastern redcedar, Austrian pine, Rocky Mountain juniper, jack pine.	Ponderosa pine----	---	---
VnF*: Valentine, rolling---------	---	Eastern redcedar, Austrian pine, Rocky Mountain juniper, jack pine.	Ponderosa pine----	---	---
Valentine, hilly.					
VnG. Valentine					
VsB--------------- Vetal	Skunkbush sumac, common chokecherry, American plum, lilac.	Siberian peashrub	Honeylocust, Austrian pine, green ash, ponderosa pine, Rocky Mountain juniper, eastern redcedar.	Siberian elm------	---
Vt---------------- Vetal	Lilac------------	Eastern redcedar, Rocky Mountain juniper, common chokecherry, Russian-olive, Siberian peashrub.	Hackberry, ponderosa pine, honeylocust, green ash.	Siberian elm------	---
WrB. Wildhorse					
WsB*: Wildhorse.					
Hoffland---------	Redosier dogwood	---	---	Golden willow-----	Eastern cottonwood.
WtB*: Wildhorse.					

See footnote at end of table.

TABLE 11.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
WtB*:					
Ipage	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe")

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ac: Alliance	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
AcB, AcC: Alliance	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
An: Almeria	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, flooding.	Severe: ponding.
Bc: Bankard	Severe: flooding.	Moderate: flooding, too sandy.	Severe: flooding.	Moderate: too sandy, flooding.
Bd: Beckton	Severe: flooding, excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Moderate: dusty.
Bf: Bolent	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Moderate: wetness.
Bh: Bridget	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
BhB: Bridget	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
Bm: Bridget	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
BnB: Bufton	Slight	Slight	Moderate: slope.	Severe: erodes easily.
BnE: Bufton	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
BoD*:				
Bufton	Slight	Slight	Severe: slope.	Severe: erodes easily.
Orella	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
BsB: Busher	Slight	Slight	Slight	Slight.
BsC: Busher	Slight	Slight	Moderate: slope.	Slight.
BsD: Busher	Slight	Slight	Severe: slope.	Slight.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
BvC*:				
Busher	Slight	Slight	Moderate: slope.	Slight.
Tassel	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight.
BvF*:				
Busher	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Tassel	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.
Ca Calamus	Severe: flooding.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Cr Crowther	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Cs Crowther	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
DuB Dailey	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
DuD Dailey	Moderate: too sandy.	Moderate: too sandy.	Severe: slope.	Moderate: too sandy.
Dw Duroc	Severe: flooding.	Slight	Slight	Slight.
DwB Duroc	Slight	Slight	Moderate: slope.	Slight.
Ec Els	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
Ef*:				
Els	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
Hoffland	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
EgB*:				
Els	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
Ipage	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
En*:				
Els	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
Tryon	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Es Elsmere	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.
EuE*:				
Enning	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: erodes easily.
Minnequa	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
EvG*:				
Enning	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: erodes easily.
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.
EwG*:				
Epping	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, erodes easily.
Badland	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
Fu Fluvaquents	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, flooding.	Severe: ponding.
Gg Gannett	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Gh Gannett	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Hm Hoffland	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Hn Hoffland	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
IpB------------------ Ipage	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
JgB------------------ Jayem	Slight---------------	Slight---------------	Moderate: small stones.	Slight.
JgC------------------ Jayem	Slight---------------	Slight---------------	Moderate: slope, small stones.	Slight.
JgD------------------ Jayem	Slight---------------	Slight---------------	Severe: slope.	Slight.
Jo------------------- Johnstown	Slight---------------	Slight---------------	Slight---------------	Slight.
Kd------------------- Kadoka	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
KdC------------------ Kadoka	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock, dusty.	Moderate: dusty.
KdD------------------ Kadoka	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Moderate: dusty.
Ke------------------- Keith	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
KeB, KeC------------- Keith	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
Kg------------------- Keith	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
KgB, KgC------------- Keith	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
Ky------------------- Keya	Slight---------------	Slight---------------	Slight---------------	Slight.
La------------------- Las Animas	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Moderate: wetness.
Lg------------------- Lodgepole	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.
Lu------------------- Lute	Severe: flooding, wetness, excess sodium.	Severe: excess sodium.	Severe: wetness, excess sodium.	Moderate: wetness.
MbC------------------ Manvel	Slight---------------	Slight---------------	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Mc: Marlake	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Mk: McCook	Severe: flooding.	Slight	Slight	Slight.
Mm: McCook	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
MxF*:				
Mitchell	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
Epping	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
My: Munjor	Severe: flooding.	Slight	Slight	Slight.
Mz: Munjor	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
OhC*:				
Oglala	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
Canyon	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight.
OhD*:				
Oglala	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
Canyon	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
OhF*:				
Oglala	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, dusty.
Canyon	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.
On: Onita	Severe: flooding.	Slight	Slight	Slight.
OrF: Orella	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
OvD: Orpha	Moderate: too sandy.	Moderate: too sandy.	Severe: slope.	Moderate: too sandy.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
OwF*:				
Orpha	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: too sandy, slope.
Niobrara	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.
OxG*:				
Orpha	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
PoC Ponderosa	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
PoD Ponderosa	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Moderate: dusty.
PtF*:				
Ponderosa	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope, dusty.
Tassel	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
Vetal	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
RoB Rosebud	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock.	Moderate: dusty.
SnB Satanta	Slight	Slight	Slight	Slight.
SnC Satanta	Slight	Slight	Moderate: slope.	Slight.
SnD Satanta	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
SsD*:				
Satanta	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Canyon	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
SsE*:				
Satanta	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
SsE*:				
Canyon	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.
TfG*:				
Tassel	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, erodes easily.
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
TgG*:				
Tassel	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, erodes easily.
Ponderosa	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
ThB, ThC Thirtynine	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
ThD Thirtynine	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Moderate: dusty.
To Tryon	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Tp Tryon	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
TtB Tuthill	Slight	Slight	Slight	Slight.
TtD Tuthill	Slight	Slight	Severe: slope.	Slight.
TwB Tuthill	Slight	Slight	Slight	Slight.
TwC Tuthill	Slight	Slight	Moderate: slope.	Slight.
TwD Tuthill	Slight	Slight	Severe: slope.	Slight.
VaB Valent	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
VaD: Valent	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
VaE: Valent	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
VaF*:				
Valent, rolling	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
Valent, hilly	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
VaG: Valent	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
VeB: Valent	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
VeD: Valent	Moderate: too sandy.	Moderate: too sandy.	Severe: slope.	Moderate: too sandy.
VnD: Valentine	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
VnE: Valentine	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
VnF*:				
Valentine, rolling	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
Valentine, hilly	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
VnG: Valentine	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
VsB, Vt: Vetal	Slight	Slight	Slight	Slight.
WrB: Wildhorse	Severe: too sandy, excess sodium.	Severe: too sandy, excess sodium.	Severe: too sandy, excess sodium.	Severe: too sandy.
WsB*:				
Wildhorse	Severe: too sandy, excess sodium.	Severe: too sandy, excess sodium.	Severe: too sandy, excess sodium.	Severe: too sandy.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
WsB*:				
Hoffland	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
WtB*:				
Wildhorse	Severe: too sandy, excess sodium.	Severe: too sandy, excess sodium.	Severe: too sandy, excess sodium.	Severe: too sandy.
Ipage	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Ac, AcB, AcC-------Alliance	Good	Good	Good	Good	Good	Good	Very poor.	Poor	Good	Good	Poor	Good.
An-----------------Almeria	Very poor.	Poor	Fair	Poor	Poor	Poor	Good	Good	Poor	Poor	Good	Poor.
Bc-----------------Bankard	Poor	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Bd-----------------Beckton	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Poor.
Bf-----------------Bolent	Poor	Fair	Good	Good	Good	Good	Fair	Very poor.	Fair	Good	Poor	Good.
Bh, BhB, Bm--------Bridget	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
BnB----------------Bufton	Fair	Good	Good	Fair	Good	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
BnE----------------Bufton	Poor	Fair	Fair	Fair	Good	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
BoD*:												
Bufton------------	Fair	Good	Good	Fair	Good	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Orella------------	Poor	Poor	Poor	Poor	Fair	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Poor.
BsB, BsC, BsD------Busher	Fair	Good	Good	Fair	Poor	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
BvC*:												
Busher------------	Fair	Good	Good	Fair	Poor	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Tassel------------	Poor	Poor	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Poor.
BvF*:												
Busher------------	Poor	Fair	Fair	Poor	Poor	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Tassel------------	Poor	Poor	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Poor.
Ca-----------------Calamus	Poor	Good	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor	Fair.
Cr, Cs-------------Crowther	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Poor	Poor	Good	Fair.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
DuB, DuD----------- Dailey	Poor	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Dw, DwB------------ Duroc	Good	Good	Fair	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.	Fair.
Ec----------------- Els	Poor	Poor	Fair	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor	Fair.
Ef*:												
Els---------------	Poor	Poor	Fair	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor	Fair.
Hoffland----------	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Poor	Poor	Good	Fair.
EgB*:												
Els---------------	Poor	Poor	Fair	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor	Fair.
Ipage-------------	Poor	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
En*:												
Els---------------	Poor	Poor	Fair	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor	Fair.
Tryon-------------	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Poor	Poor	Good	Fair.
Es----------------- Elsmere	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair.
EuE*:												
Enning------------	Very poor.	Very poor.	Fair	Poor	Very poor.	---	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Fair.
Minnequa----------	Poor	Poor	Fair	---	---	Poor	Poor	Very poor.	Poor	---	Very poor.	Poor.
EvG*:												
Enning------------	Very poor.	Very poor.	Fair	Poor	Very poor.	---	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Fair.
Rock outcrop------	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
EwG*:												
Epping------------	Very poor.	Very poor.	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
Badland-----------	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Fu----------------- Fluvaquents	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	Very poor.
Gg, Gh------------- Gannett	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Poor	Poor	Good	Fair.
Hm, Hn------------- Hoffland	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Poor	Poor	Good	Fair.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
IpB----------------- Ipage	Poor	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
JgB, JgC----------- Jayem	Fair	Good	Fair	Good	Good	Fair	Poor	Very poor.	Fair	Good	Very poor.	Fair.
JgD----------------- Jayem	Fair	Good	Fair	Good	Good	Fair	Poor	Very poor.	Fair	Good	Very poor.	Fair.
Jo------------------ Johnstown	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Kd------------------ Kadoka	Good	Good	Fair	Good	Very poor.	Fair	Poor	Very poor.	Good	Very poor.	Very poor.	Fair.
KdC, KdD----------- Kadoka	Fair	Good	Fair	Good	Good	Fair	Poor	Very poor.	Fair	Good	Very poor.	Fair.
Ke, KeB------------ Keith	Good	Good	Good	Fair	Fair	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
KeC----------------- Keith	Fair	Good	Good	Fair	Fair	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Kg, KgB------------ Keith	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
KgC----------------- Keith	Fair	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
Ky------------------ Keya	Good	Good	Fair	Good	Poor	---	Very poor.	Very poor.	Good	Poor	Very poor.	Fair.
La------------------ Las Animas	Fair	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair	Good.
Lg------------------ Lodgepole	Poor	Fair	Fair	Poor	Poor	Poor	Good	Good	Fair	Poor	Good	Poor.
Lu------------------ Lute	Very poor.	Very poor.	Poor	Poor	Very poor.	---	Poor	Poor	Very poor.	Very poor.	Poor	Poor.
MbC----------------- Manvel	Poor	Fair	Fair	Poor	Very poor.	---	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Mc------------------ Marlake	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	Very poor.
Mk------------------ McCook	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
Mm------------------ McCook	Poor	Poor	Fair	Good	Fair	Good	Very poor.	Very poor.	Poor	Fair	Very poor.	Good.
MxF*:												
Mitchell-----------	Poor	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
Epping-------------	Poor	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
My-----------------: Munjor	Fair	Good	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.	Fair.
Mz-----------------: Munjor	Poor	Poor	Fair	Good	Good	Good	Poor	Very poor.	Poor	Fair	Very poor.	Fair.
OhC*, OhD*:												
Oglala------------	Fair	Good	Good	Good	Good	Fair	Poor	Very poor.	Fair	Good	Very poor.	Fair.
Canyon------------	Poor	Poor	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
OhF*:												
Oglala------------	Poor	Fair	Good	Good	Good	Fair	Poor	Very poor.	Fair	Good	Very poor.	Fair.
Canyon------------	Poor	Poor	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
On-----------------: Onita	Good	Good	Fair	Good	Poor	---	Very poor.	Very poor.	Good	Poor	Very poor.	Fair.
OrF----------------: Orella	Poor	Poor	Poor	Poor	Fair	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Poor.
OvD----------------: Orpha	Poor	Fair	Fair	Poor	Poor	Fair	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
OwF*:												
Orpha-------------	Poor	Fair	Fair	Poor	Poor	Fair	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
Niobrara----------	Poor	Poor	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Poor.
OxG*:												
Orpha-------------	Very poor.	Very poor.	Fair	Poor	Poor	Fair	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Poor.
Rock outcrop------	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
PoC, PoD-----------: Ponderosa	Poor	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
PtF*:												
Ponderosa---------	Poor	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
Tassel------------	Poor	Poor	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Poor.
Vetal-------------	Poor	Good	Good	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.	Good.
RoB----------------: Rosebud	Good	Good	Fair	---	Good	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life	Range- land wild- life
SnB: Satanta	Good	Good	Fair	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.	Fair.
SnC, SnD: Satanta	Fair	Good	Fair	Good	Good	Fair	Poor	Very poor.	Fair	Good	Very poor.	Fair.
SsD*:												
Satanta	Fair	Good	Fair	Good	Good	Fair	Poor	Very poor.	Fair	Good	Very poor.	Fair.
Canyon	Poor	Poor	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
SsE*:												
Satanta	Poor	Fair	Fair	Good	Good	Fair	Poor	Very poor.	Poor	Good	Very poor.	Fair.
Canyon	Poor	Poor	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Fair	Very poor.	Fair.
TfG*:												
Tassel	Very poor.	Very poor.	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Poor.
Rock outcrop	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
TgG*:												
Tassel	Very poor.	Very poor.	Poor	Fair	Fair	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Poor.
Ponderosa	Very poor.	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.	Poor.
Rock outcrop	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
ThB: Thirtynine	Good	Good	Good	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.	Good.
ThC, ThD: Thirtynine	Fair	Good	Good	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.	Fair.
To, Tp: Tryon	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Poor	Poor	Good	Fair.
TtB: Tuthill	Fair	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
TtD: Tuthill	Poor	Fair	Good	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.	Good.
TwB, TwC: Tuthill	Fair	Fair	Good	Fair	Very poor.	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Good.
TwD: Tuthill	Poor	Fair	Good	Fair	Very poor.	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Good.
VaB, VaD, VaE: Valent	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
VaF*:												
Valent, rolling	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
Valent, hilly	Very poor.	Very poor.	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
VaG Valent	Very poor.	Very poor.	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
VeB Valent	Fair	Good	Fair	Poor	Fair	Fair	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
VeD Valent	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
VnD, VnE Valentine	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
VnF*:												
Valentine, rolling	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
Valentine, hilly	Very poor.	Very poor.	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
VnG Valentine	Very poor.	Very poor.	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.
VsB Vetal	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.	Fair.
Vt Vetal	Fair	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
WrB Wildhorse	Poor	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Fair	Poor	Poor	Fair	Poor.
WsB*:												
Wildhorse	Poor	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Fair	Poor	Poor	Fair	Poor.
Hoffland	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Poor	Poor	Good	Fair.
WtB*:												
Wildhorse	Poor	Poor	Fair	Very poor.	Very poor.	Poor	Fair	Fair	Poor	Poor	Fair	Poor.
Ipage	Poor	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Ac, AcB: Alliance	Slight	Slight	Slight	Slight	Moderate: frost action.	Slight.
AcC: Alliance	Slight	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
An: Almeria	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding.	Severe: ponding, flooding.
Bc: Bankard	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Bd: Beckton	Moderate: too clayey, wetness.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength.	Severe: excess sodium.
Bf: Bolent	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding.	Moderate: wetness, droughty, flooding.
Bh, BhB, Bm: Bridget	Slight	Slight	Slight	Slight	Moderate: low strength.	Slight.
BnB: Bufton	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
BnE: Bufton	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: slope.
BoD*:						
Bufton	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
Orella	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: depth to rock.
BsB: Busher	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Slight.
BsC, BsD: Busher	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Slight.
BvC*:						
Busher	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Slight.
Tassel	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.

See footnote at end of table.

TABLE 14.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
BvF*:						
Busher	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Tassel	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.
Ca: Calamus	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Severe: droughty.
Cr: Crowther	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness.	Severe: wetness.
Cs: Crowther	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: low strength, ponding.	Severe: ponding.
DuB: Dailey	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
DuD: Dailey	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
Dw: Duroc	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: shrink-swell, low strength, flooding.	Slight.
DwB: Duroc	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.	Slight.
Ec: Els	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Moderate: wetness, droughty.
Ef*:						
Els	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Moderate: wetness, droughty.
Hoffland	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.
EgB*:						
Els	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Moderate: wetness, droughty.
Ipage	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Severe: droughty.

See footnote at end of table.

TABLE 14.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
En*:						
Els	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Moderate: wetness, droughty.
Tryon	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.
Es Elsmere	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding, frost action.	Moderate: wetness, droughty.
EuE*:						
Enning	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Severe: thin layer, area reclaim.
Minnequa	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: low strength, slope.	Moderate: slope, depth to rock.
EvG*:						
Enning	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope, thin layer, area reclaim.
Rock outcrop	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
EwG*:						
Epping	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.
Badland	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.
Fu Fluvaquents	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding.	Severe: ponding, flooding.
Gg Gannett	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, frost action.	Severe: wetness.
Gh Gannett	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, frost action.	Severe: ponding.
Hm Hoffland	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.

See footnote at end of table.

TABLE 14.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Hn: Hoffland	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.
IpB: Ipage	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Severe: droughty.
JgB: Jayem	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Slight.
JgC, JgD: Jayem	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Slight.
Jo: Johnstown	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Kd: Kadoka	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Slight	Severe: low strength.	Moderate: depth to rock.
KdC, KdD: Kadoka	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Severe: low strength.	Moderate: depth to rock.
Ke, KeB: Keith	Slight	Slight	Slight	Slight	Moderate: low strength, frost action.	Slight.
KeC: Keith	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength, frost action.	Slight.
Kg, KgB: Keith	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Slight.
KgC: Keith	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
Ky: Keya	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.	Slight.
La: Las Animas	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding.	Moderate: wetness, flooding.
Lg: Lodgepole	Severe: cutbanks cave, ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
Lu: Lute	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: frost action.	Severe: excess sodium.
MbC: Manvel	Slight	Slight	Slight	Moderate: slope.	Severe: low strength.	Slight.
Mc: Marlake	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

See footnote at end of table.

TABLE 14.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Mk---------------- McCook	Slight----------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.	Slight.
Mm---------------- McCook	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
MxF*:						
Mitchell----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Epping-----------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.
My---------------- Munjor	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
Mz---------------- Munjor	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
OhC*:						
Oglala-----------	Severe: cutbanks cave.	Slight----------	Slight----------	Moderate: slope.	Moderate: frost action.	Slight.
Canyon-----------	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.	Severe: depth to rock.
OhD*:						
Oglala-----------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Canyon-----------	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.	Severe: depth to rock.
OhF*:						
Oglala-----------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Canyon-----------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.
On---------------- Onita	Moderate: too clayey, wetness.	Severe: flooding, shrink-swell.	Severe: flooding.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
OrF--------------- Orella	Severe: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope, depth to rock.
OvD--------------- Orpha	Severe: cutbanks cave.	Slight----------	Slight----------	Moderate: slope.	Slight----------	Moderate: droughty.

See footnote at end of table.

TABLE 14.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
OwF*:						
Orpha	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Niobrara	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.
OxG*:						
Orpha	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rock outcrop	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
PoC, PoD Ponderosa	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Slight.
PtF*:						
Ponderosa	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Tassel	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.
Vetal	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
RoB Rosebud	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Slight	Moderate: frost action.	Moderate: depth to rock.
SnB Satanta	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.	Slight.
SnC Satanta	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Slight.
SnD Satanta	Severe: cutbanks cave.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope.
SsD*:						
Satanta	Severe: cutbanks cave.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope.
Canyon	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.	Severe: depth to rock.

See footnote at end of table.

TABLE 14.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
SsE*:						
Satanta	Severe: cutbanks cave.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: slope.
Canyon	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.
TfG*:						
Tassel	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.
Rock outcrop	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
TgG*:						
Tassel	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.
Ponderosa	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rock outcrop	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
ThB Thirtynine	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.	Slight.
ThC, ThD Thirtynine	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
To Tryon	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.
Tp Tryon	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.
TtB Tuthill	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Slight.
TtD Tuthill	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Moderate: shrink-swell.	Slight.
TwB Tuthill	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: droughty.
TwC, TwD Tuthill	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell.	Moderate: droughty.

See footnote at end of table.

TABLE 14.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
VaB: Valent	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
VaD: Valent	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
VaE: Valent	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
VaF*:						
Valent, rolling	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Valent, hilly	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
VaG: Valent	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
VeB: Valent	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
VeD: Valent	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
VnD: Valentine	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
VnE: Valentine	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
VnF*:						
Valentine, rolling	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Valentine, hilly	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
VnG: Valentine	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
VsB, Vt: Vetal	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Slight.
WrB: Wildhorse	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Severe: excess sodium, droughty.
WsB*:						
Wildhorse	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Severe: excess sodium, droughty.

See footnote at end of table.

TABLE 14.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
WsB*:						
Hoffland	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.
WtB*:						
Wildhorse	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Severe: excess sodium, droughty.
Ipage	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Moderate: frost action.	Severe: droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ac: Alliance	Moderate: depth to rock, percs slowly.	Moderate: seepage, depth to rock.	Severe: depth to rock.	Slight	Fair: depth to rock.
AcB, AcC: Alliance	Moderate: depth to rock, percs slowly.	Moderate: seepage, depth to rock, slope.	Severe: depth to rock.	Slight	Fair: depth to rock.
An: Almeria	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, ponding.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: seepage, too sandy, ponding.
Bc: Bankard	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, too sandy.	Severe: flooding.	Poor: seepage, too sandy.
Bd: Beckton	Severe: percs slowly.	Moderate: seepage.	Severe: wetness, excess salt.	Moderate: flooding, wetness.	Good.
Bf: Bolent	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy.
Bh: Bridget	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Good.
BhB: Bridget	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
Bm: Bridget	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Good.
BnB: Bufton	Severe: percs slowly.	Moderate: slope.	Slight	Slight	Poor: hard to pack.
BnE: Bufton	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: hard to pack.
BoD*:					
Bufton	Severe: percs slowly.	Moderate: slope.	Slight	Slight	Poor: hard to pack.
Orella	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: depth to rock, hard to pack.
BsB, BsC: Busher	Moderate: depth to rock.	Severe: seepage.	Severe: depth to rock.	Slight	Fair: depth to rock, thin layer.

See footnote at end of table.

TABLE 15.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
BsD------------------ Busher	Moderate: depth to rock.	Severe: seepage, slope.	Severe: depth to rock.	Slight-----------	Fair: depth to rock, thin layer.
BvC*:					
Busher-------------	Moderate: depth to rock.	Severe: seepage.	Severe: depth to rock.	Slight-----------	Fair: depth to rock, thin layer.
Tassel-------------	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock.	Slight-----------	Poor: depth to rock.
BvF*:					
Busher-------------	Severe: slope.	Severe: seepage, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: slope.
Tassel-------------	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
Ca------------------ Calamus	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Cr------------------ Crowther	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
Cs------------------ Crowther	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
DuB, DuD------------ Dailey	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Dw------------------ Duroc	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
DwB----------------- Duroc	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
Ec------------------ Els	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Ef*:					
Els----------------	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.

See footnote at end of table.

TABLE 15.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ef*:					
Hoffland	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
EgB*:					
Els	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Ipage	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
En*:					
Els	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Tryon	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
Es Elsmere	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage.
EuE*:					
Enning	Severe: thin layer, seepage.	Severe: seepage, slope.	Severe: seepage.	Moderate: slope.	Poor: area reclaim, hard to pack.
Minnequa	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock.
EvG*:					
Enning	Severe: thin layer, seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: slope.	Poor: area reclaim, hard to pack, slope.
Rock outcrop	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
EwG*:					
Epping	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
Badland	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.

See footnote at end of table.

TABLE 15.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Fu: Fluvaquents	Severe: flooding, ponding.	Severe: seepage, flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding.
Gg: Gannett	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
Gh: Gannett	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Hm: Hoffland	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
Hn: Hoffland	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
IpB: Ipage	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.
JgB, JgC: Jayem	Slight	Severe: seepage.	Moderate: too sandy.	Slight	Good.
JgD: Jayem	Slight	Severe: seepage, slope.	Moderate: too sandy.	Slight	Good.
Jo: Johnstown	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Fair: too clayey, thin layer.
Kd, KdC: Kadoka	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: depth to rock.
KdD: Kadoka	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Slight	Poor: depth to rock.
Ke: Keith	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Good.
KeB, KeC: Keith	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
Kg: Keith	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Fair: thin layer.
KgB, KgC: Keith	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Fair: thin layer.

See footnote at end of table.

TABLE 15.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ky------------------ Keya	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
La------------------ Las Animas	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Fair: too sandy, wetness, thin layer.
Lg------------------ Lodgepole	Severe: ponding, percs slowly.	Severe: seepage, ponding.	Severe: seepage, ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Lu------------------ Lute	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, excess sodium.	Severe: seepage, wetness.	Poor: wetness, excess sodium.
MbC----------------- Manvel	Severe: percs slowly.	Moderate: slope.	Slight-----------	Slight-----------	Good.
Mc------------------ Marlake	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Mk------------------ McCook	Moderate: flooding, percs slowly.	Severe: seepage.	Severe: seepage.	Moderate: flooding.	Good.
Mm------------------ McCook	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
MxF*:					
Mitchell------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Epping--------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
My------------------ Munjor	Moderate: flooding.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: thin layer.
Mz------------------ Munjor	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Fair: thin layer.
OhC*:					
Oglala--------------	Moderate: depth to rock, percs slowly.	Moderate: seepage, depth to rock, slope.	Severe: depth to rock.	Slight-----------	Fair: depth to rock, thin layer.
Canyon--------------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight-----------	Poor: depth to rock.

See footnote at end of table.

TABLE 15.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
OhD*:					
Oglala	Moderate: depth to rock, percs slowly, slope.	Severe: slope.	Severe: depth to rock.	Moderate: slope.	Fair: depth to rock, slope, thin layer.
Canyon	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock.
OhF*:					
Oglala	Severe: slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: slope.
Canyon	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
On: Onita	Severe: wetness, percs slowly.	Moderate: seepage.	Moderate: flooding, wetness, too clayey.	Moderate: flooding.	Poor: hard to pack.
OrF: Orella	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, hard to pack, slope.
OvD: Orpha	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight	Poor: too sandy.
OwF*:					
Orpha	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: slope.	Poor: too sandy, slope.
Niobrara	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
OxG*:					
Orpha	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: slope.	Poor: too sandy, slope.
Rock outcrop	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
PoC: Ponderosa	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
PoD: Ponderosa	Slight	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Good.

See footnote at end of table.

TABLE 15.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
PtF*:					
Ponderosa	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.
Tassel	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
Vetal	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope, thin layer.
RoB Rosebud	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: depth to rock.
SnB, SnC Satanta	Moderate: percs slowly.	Severe: seepage.	Slight	Slight	Good.
SnD Satanta	Moderate: percs slowly, slope.	Severe: seepage, slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
SsD*:					
Satanta	Moderate: percs slowly, slope.	Severe: seepage, slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Canyon	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock.
SsE*:					
Satanta	Moderate: percs slowly, slope.	Severe: seepage, slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Canyon	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
TfG*:					
Tassel	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
Rock outcrop	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
TgG*:					
Tassel	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
Ponderosa	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: slope.

See footnote at end of table.

TABLE 15.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
TgG*:					
Rock outcrop	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
ThB, ThC: Thirtynine	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
ThD: Thirtynine	Moderate: percs slowly.	Severe: slope.	Slight	Slight	Good.
To: Tryon	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
Tp: Tryon	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
TtB: Tuthill	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight	Poor: seepage, too sandy.
TtD: Tuthill	Severe: poor filter.	Severe: seepage, slope.	Severe: too sandy.	Slight	Poor: seepage, too sandy.
TwB, TwC: Tuthill	Severe: poor filter.	Severe: seepage.	Slight	Slight	Fair: thin layer.
TwD: Tuthill	Severe: poor filter.	Severe: seepage, slope.	Slight	Slight	Fair: thin layer.
VaB, VaD: Valent	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight	Poor: seepage, too sandy.
VaE: Valent	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: slope.	Poor: seepage, too sandy, slope.
VaF*:					
Valent, rolling	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: slope.	Poor: seepage, too sandy, slope.
Valent, hilly	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: slope.	Poor: seepage, too sandy, slope.
VaG: Valent	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: slope.	Poor: seepage, too sandy, slope.

See footnote at end of table.

TABLE 15.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
VeB, VeD: Valent	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight	Poor: seepage, too sandy.
VnD: Valentine	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
VnE: Valentine	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
VnF*:					
Valentine, rolling	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
Valentine, hilly	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
VnG: Valentine	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
VsB, Vt: Vetal	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: thin layer.
WrB: Wildhorse	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, excess sodium.
WsB*:					
Wildhorse	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, excess sodium.
Hoffland	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
WtB*:					
Wildhorse	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, excess sodium.
Ipage	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ac, AcB, AcC Alliance	Fair: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
An Almeria	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
Bc Bankard	Good	Probable	Improbable: too sandy.	Poor: area reclaim, too sandy.
Bd Beckton	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Bf Bolent	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
Bh, BhB, Bm Bridget	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
BnB, BnE Bufton	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
BoD*:				
Bufton	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Orella	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey, excess salt.
BsB, BsC, BsD Busher	Fair: depth to rock, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, small stones.
BvC*:				
Busher	Fair: depth to rock, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, small stones.
Tassel	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
BvF*:				
Busher	Fair: depth to rock, thin layer, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

See footnote at end of table.

TABLE 16.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
BvF*:				
Tassel	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
Ca Calamus	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Cr, Cs Crowther	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
DuB, DuD Dailey	Good	Probable	Improbable: too sandy.	Poor: area reclaim, too sandy.
Dw, DwB Duroc	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ec Els	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
Ef*:				
Els	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
Hoffland	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
EgB*:				
Els	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
Ipage	Good	Probable	Improbable: too sandy.	Poor: too sandy.
En*:				
Els	Fair: wetness.	Probable	Improbable: too sandy.	Poor: too sandy.
Tryon	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
Es Elsmere	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too sandy.
EuE*:				
Enning	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, area reclaim.
Minnequa	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, too clayey, slope.

See footnote at end of table.

TABLE 16.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
EvG*:				
Enning	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, area reclaim, slope.
Rock outcrop	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
EwG*:				
Epping	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
Badland	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
Fu Fluvaquents	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
Gg, Gh Gannett	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
Hm, Hn Hoffland	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
IpB Ipage	Good	Probable	Improbable: too sandy.	Poor: too sandy.
JgB, JgC, JgD Jayem	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, small stones.
Jo Johnstown	Good	Probable	Probable	Good.
Kd, KdC, KdD Kadoka	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones, thin layer.
Ke, KeB, KeC Keith	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Kg, KgB, KgC Keith	Good	Probable	Probable	Fair: area reclaim.
Ky Keya	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
La Las Animas	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too sandy, small stones.
Lg Lodgepole	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.

See footnote at end of table.

TABLE 16.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Lu: Lute	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, excess sodium.
MbC: Manvel	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Mc: Marlake	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
Mk, Mm: McCook	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
MxF*:				
Mitchell	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Epping	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
My, Mz: Munjor	Good	Probable	Improbable: too sandy.	Fair: too sandy, small stones.
OhC*:				
Oglala	Poor: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Good.
Canyon	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
OhD*:				
Oglala	Poor: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Canyon	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
OhF*:				
Oglala	Poor: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Canyon	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
On: Onita	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
OrF: Orella	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey, excess salt.
OvD: Orpha	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.

See footnote at end of table.

TABLE 16.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
OwF*:				
Orpha	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, slope.
Niobrara	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, area reclaim, slope.
OxG*:				
Orpha	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy, slope.
Rock outcrop	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
PoC, PoD Ponderosa	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, small stones.
PtF*:				
Ponderosa	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Tassel	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
Vetal	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
RoB Rosebud	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones.
SnB, SnC Satanta	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
SnD Satanta	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
SsD*:				
Satanta	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
Canyon	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
SsE*:				
Satanta	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.

See footnote at end of table.

TABLE 16.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
SsE*:				
Canyon	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
TfG*:				
Tassel	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
Rock outcrop	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
TgG*:				
Tassel	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
Ponderosa	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Rock outcrop	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
ThB, ThC, ThD Thirtynine	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
To, Tp Tryon	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
TtB, TtD Tuthill	Good	Probable	Improbable: too sandy.	Fair: too clayey, thin layer.
TwB, TwC, TwD Tuthill	Good	Probable	Improbable: too sandy.	Fair: too clayey.
VaB, VaD Valent	Good	Probable	Improbable: too sandy.	Poor: too sandy.
VaE Valent	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
VaF*:				
Valent, rolling	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
Valent, hilly	Poor: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
VaG Valent	Poor: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.

See footnote at end of table.

TABLE 16.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
VeB, VeD: Valent	Good	Probable	Improbable: too sandy.	Poor: too sandy.
VnD: Valentine	Good	Probable	Improbable: too sandy.	Poor: too sandy.
VnE: Valentine	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
VnF*:				
Valentine, rolling	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
Valentine, hilly	Poor: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
VnG: Valentine	Poor: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
VsB: Vetal	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Vt: Vetal	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
WrB: Wildhorse	Fair: wetness.	Probable	Improbable: too sandy.	Poor: area reclaim, too sandy, excess sodium.
WsB*:				
Wildhorse	Fair: wetness.	Probable	Improbable: too sandy.	Poor: area reclaim, too sandy, excess sodium.
Hoffland	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
WtB*:				
Wildhorse	Fair: wetness.	Probable	Improbable: too sandy.	Poor: area reclaim, too sandy, excess sodium.
Ipage	Good	Probable	Improbable: too sandy.	Poor: too sandy.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ac, AcB------------ Alliance	Moderate: seepage, depth to rock.	Severe: piping.	Deep to water	Favorable-------	Erodes easily	Too arid, erodes easily.
AcC---------------- Alliance	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Slope-----------	Erodes easily	Too arid, erodes easily.
An----------------- Almeria	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, flooding, cutbanks cave.	Ponding, droughty, fast intake.	Ponding, too sandy.	Wetness, droughty, rooting depth.
Bc----------------- Bankard	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Too arid, droughty, rooting depth.
Bd----------------- Beckton	Slight----------	Severe: excess sodium, excess salt.	Deep to water	Percs slowly, excess sodium.	Percs slowly---	Too arid, excess salt, excess sodium.
Bf----------------- Bolent	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty, rooting depth.
Bh, BhB------------ Bridget	Moderate: seepage.	Severe: piping.	Deep to water	Soil blowing---	Erodes easily, soil blowing.	Too arid, erodes easily.
Bm----------------- Bridget	Moderate: seepage.	Severe: piping.	Deep to water	Favorable-------	Erodes easily	Too arid, erodes easily.
BnB---------------- Bufton	Slight----------	Moderate: hard to pack.	Deep to water	Percs slowly---	Erodes easily, percs slowly.	Too arid, erodes easily.
BnE---------------- Bufton	Severe: slope.	Moderate: hard to pack.	Deep to water	Slope, percs slowly.	Slope, erodes easily, percs slowly.	Too arid, slope, erodes easily.
BoD*:						
Bufton------------	Moderate: slope.	Moderate: hard to pack.	Deep to water	Slope, percs slowly.	Erodes easily, percs slowly.	Too arid, erodes easily.
Orella------------	Severe: depth to rock.	Severe: hard to pack.	Deep to water	Slope, droughty.	Depth to rock, erodes easily.	Too arid, erodes easily.
BsB---------------- Busher	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing---	Soil blowing---	Too arid.
BsC, BsD----------- Busher	Severe: seepage.	Severe: piping.	Deep to water	Slope, soil blowing.	Soil blowing---	Too arid.

See footnote at end of table.

TABLE 17.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
BvC*:						
Busher	Severe: seepage.	Severe: piping.	Deep to water	Slope, soil blowing.	Soil blowing	Too arid.
Tassel	Severe: depth to rock.	Slight	Deep to water	Slope, soil blowing, depth to rock.	Depth to rock	Too arid.
BvF*:						
Busher	Severe: seepage, slope.	Severe: piping.	Deep to water	Slope, soil blowing.	Slope, soil blowing.	Too arid, slope.
Tassel	Severe: depth to rock, slope.	Slight	Deep to water	Slope, soil blowing, depth to rock.	Slope, depth to rock.	Too arid, slope.
Ca: Calamus	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Cr: Crowther	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness	Wetness, too sandy.	Wetness.
Cs: Crowther	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding	Ponding, too sandy.	Wetness.
DuB: Dailey	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Too arid, droughty.
DuD: Dailey	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Too arid, droughty.
Dw, DwB: Duroc	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
Ec: Els	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty.
Ef*:						
Els	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty.
Hoffland	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy.	Wetness, droughty.

See footnote at end of table.

TABLE 17.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
EgB*:						
Els	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty.
Ipage	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Droughty.
En*:						
Els	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty.
Tryon	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy.	Wetness, droughty.
Es Elsmere	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty.
EuE*:						
Enning	Severe: seepage, slope.	Severe: hard to pack, thin layer.	Deep to water	Slope, thin layer, erodes easily.	Slope, area reclaim, erodes easily.	Slope, erodes easily, area reclaim.
Minnequa	Severe: slope.	Severe: piping.	Deep to water	Slope, depth to rock.	Slope, depth to rock, erodes easily.	Too arid, slope, erodes easily.
EvG*:						
Enning	Severe: seepage, slope.	Severe: hard to pack, thin layer.	Deep to water	Slope, thin layer, erodes easily.	Slope, area reclaim, erodes easily.	Slope, erodes easily, area reclaim.
Rock outcrop	Severe: depth to rock, slope.	Severe: area reclaim.	Deep to water	Slope, depth to rock.	Slope, depth to rock.	Slope, depth to rock.
EwG*:						
Epping	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Slope, soil blowing, depth to rock.	Slope, depth to rock, erodes easily.	Too arid, slope, erodes easily.
Badland	Severe: depth to rock, slope.	Slight	Deep to water	Slope, depth to rock.	Slope, depth to rock.	Slope, depth to rock.
Fu Fluvaquents	Severe: seepage.	Severe: seepage, ponding.	Ponding, flooding.	Ponding, droughty, rooting depth.	Ponding, too sandy.	Wetness, droughty, rooting depth.
Gg Gannett	Severe: seepage.	Severe: seepage, piping, wetness.	Frost action, cutbanks cave.	Wetness, droughty.	Wetness, too sandy.	Wetness, droughty.

See footnote at end of table.

TABLE 17.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Gh---------------- Gannett	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, frost action, cutbanks cave.	Ponding, droughty.	Ponding, too sandy.	Wetness, droughty.
Hm---------------- Hoffland	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy.	Wetness, droughty.
Hn---------------- Hoffland	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding, droughty.	Ponding, too sandy.	Wetness, droughty.
IpB--------------- Ipage	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Droughty.
JgB--------------- Jayem	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing---	Soil blowing---	Too arid.
JgC, JgD---------- Jayem	Severe: seepage.	Severe: piping.	Deep to water	Slope, soil blowing.	Soil blowing---	Too arid.
Jo---------------- Johnstown	Severe: seepage.	Severe: thin layer.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Kd---------------- Kadoka	Moderate: seepage, depth to rock.	Severe: piping.	Deep to water	Depth to rock	Depth to rock, erodes easily.	Too arid, erodes easily.
KdC, KdD---------- Kadoka	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Slope, depth to rock.	Depth to rock, erodes easily.	Too arid, erodes easily.
Ke, KeB----------- Keith	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Too arid, erodes easily.
KeC--------------- Keith	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Too arid, erodes easily.
Kg, KgB----------- Keith	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Too arid, erodes easily.
KgC--------------- Keith	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Too arid, erodes easily.
Ky---------------- Keya	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Favorable------	Favorable.
La---------------- Las Animas	Severe: seepage.	Severe: piping, wetness.	Flooding, cutbanks cave.	Wetness, flooding.	Wetness--------	Favorable.
Lg---------------- Lodgepole	Severe: seepage.	Severe: ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly, erodes easily.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.

See footnote at end of table.

TABLE 17.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Lu----------------- Lute	Severe: seepage.	Severe: seepage, piping, excess sodium.	Percs slowly, frost action, cutbanks cave.	Wetness, droughty.	Wetness, too sandy.	Wetness, excess salt, excess sodium.
MbC---------------- Manvel	Moderate: slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Too arid, erodes easily.
Mc----------------- Marlake	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding, droughty.	Ponding, too sandy.	Wetness, droughty.
Mk----------------- McCook	Severe: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Mm----------------- McCook	Moderate: seepage.	Severe: piping.	Deep to water	Flooding-------	Erodes easily	Erodes easily.
MxF*:						
Mitchell---------	Severe: slope.	Severe: piping.	Deep to water	Slope, soil blowing, erodes easily.	Slope, erodes easily, soil blowing.	Too arid, slope, erodes easily.
Epping-----------	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Slope, soil blowing, depth to rock.	Slope, depth to rock, erodes easily.	Too arid, slope, erodes easily.
My----------------- Munjor	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing---	Favorable------	Favorable.
Mz----------------- Munjor	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, flooding.	Favorable------	Favorable.
OhC*:						
Oglala-----------	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Too arid, erodes easily.
Canyon-----------	Severe: depth to rock.	Slight---------	Deep to water	Slope, depth to rock.	Depth to rock	Too arid.
OhD*, OhF*:						
Oglala-----------	Severe: slope.	Severe: piping.	Deep to water	Slope----------	Slope, erodes easily.	Too arid, slope, erodes easily.
Canyon-----------	Severe: depth to rock, slope.	Slight---------	Deep to water	Slope, depth to rock.	Slope, depth to rock.	Too arid, slope.
On----------------- Onita	Moderate: seepage.	Moderate: piping, hard to pack.	Deep to water	Percs slowly---	Erodes easily	Erodes easily, percs slowly.
OrF---------------- Orella	Severe: depth to rock, slope.	Severe: hard to pack.	Deep to water	Slope, droughty.	Slope, depth to rock, erodes easily.	Too arid, slope, erodes easily.

See footnote at end of table.

TABLE 17.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
OvD-------------- Orpha	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Too arid, droughty.
OwF*:						
Orpha------------	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Too arid, slope, droughty.
Niobrara---------	Severe: depth to rock, slope.	Slight---------	Deep to water	Slope, droughty, fast intake.	Slope, depth to rock, soil blowing.	Too arid, slope, droughty.
OxG*:						
Orpha------------	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Too arid, slope, droughty.
Rock outcrop-----	Severe: depth to rock, slope.	Severe: area reclaim.	Deep to water	Slope, depth to rock.	Slope, depth to rock.	Slope, depth to rock.
PoC, PoD---------- Ponderosa	Severe: seepage.	Severe: piping.	Deep to water	Slope, soil blowing.	Erodes easily, soil blowing.	Too arid, erodes easily.
PtF*:						
Ponderosa--------	Severe: seepage, slope.	Severe: piping.	Deep to water	Slope, soil blowing.	Slope, erodes easily, soil blowing.	Too arid, slope, erodes easily.
Tassel-----------	Severe: depth to rock, slope.	Slight---------	Deep to water	Slope, soil blowing, depth to rock.	Slope, depth to rock, erodes easily.	Too arid, slope, erodes easily.
Vetal------------	Severe: seepage, slope.	Severe: piping.	Deep to water	Slope, soil blowing.	Slope, soil blowing.	Slope.
RoB-------------- Rosebud	Moderate: seepage, depth to rock.	Severe: piping.	Deep to water	Depth to rock	Depth to rock, erodes easily.	Too arid, erodes easily.
SnB-------------- Satanta	Severe: seepage.	Severe: thin layer.	Deep to water	Soil blowing---	Soil blowing---	Too arid.
SnC-------------- Satanta	Severe: seepage.	Severe: thin layer.	Deep to water	Slope, soil blowing.	Soil blowing---	Too arid.
SnD-------------- Satanta	Severe: seepage, slope.	Severe: thin layer.	Deep to water	Slope, soil blowing.	Slope, soil blowing.	Too arid, slope.
SsD*, SsE*:						
Satanta----------	Severe: seepage, slope.	Severe: thin layer.	Deep to water	Slope, soil blowing.	Slope, soil blowing.	Too arid, slope.
Canyon-----------	Severe: depth to rock, slope.	Slight---------	Deep to water	Slope, depth to rock.	Slope, depth to rock.	Too arid, slope.

See footnote at end of table.

TABLE 17.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
TfG*:						
Tassel	Severe: depth to rock, slope.	Slight	Deep to water	Slope, soil blowing, depth to rock.	Slope, depth to rock, erodes easily.	Too arid, slope, erodes easily.
Rock outcrop	Severe: depth to rock, slope.	Severe: area reclaim.	Deep to water	Slope, depth to rock.	Slope, depth to rock.	Slope, depth to rock.
TgG*:						
Tassel	Severe: depth to rock, slope.	Slight	Deep to water	Slope, soil blowing, depth to rock.	Slope, depth to rock, erodes easily.	Too arid, slope, erodes easily.
Ponderosa	Severe: seepage, slope.	Severe: piping.	Deep to water	Slope, soil blowing.	Slope, erodes easily, soil blowing.	Too arid, slope, erodes easily.
Rock outcrop	Severe: depth to rock, slope.	Severe: area reclaim.	Deep to water	Slope, depth to rock.	Slope, depth to rock.	Slope, depth to rock.
ThB Thirtynine	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Too arid, erodes easily.
ThC, ThD Thirtynine	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Too arid, erodes easily.
To Tryon	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy.	Wetness, droughty.
Tp Tryon	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding, droughty.	Ponding, too sandy.	Wetness, droughty.
TtB Tuthill	Severe: seepage.	Severe: seepage, piping.	Deep to water	Fast intake, soil blowing.	Erodes easily, too sandy.	Too arid, erodes easily.
TtD Tuthill	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, fast intake, soil blowing.	Erodes easily, too sandy.	Too arid, erodes easily.
TwB Tuthill	Severe: seepage.	Severe: piping.	Deep to water	Droughty	Soil blowing	Too arid, droughty.
TwC, TwD Tuthill	Severe: seepage.	Severe: piping.	Deep to water	Slope, droughty.	Soil blowing	Too arid, droughty.
VaB Valent	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Too arid, droughty.
VaD Valent	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Too arid, droughty.

See footnote at end of table.

TABLE 17.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
VaE---------------Valent	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Too arid, slope, droughty.
VaF*:						
Valent, rolling--	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Too arid, slope, droughty.
Valent, hilly----	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Too arid, slope, droughty.
VaG---------------Valent	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Too arid, slope, droughty.
VeB---------------Valent	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Too arid, droughty.
VeD---------------Valent	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Too arid, droughty.
VnD---------------Valentine	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty, rooting depth.
VnE---------------Valentine	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.
VnF*:						
Valentine, rolling---------	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.
Valentine, hilly-	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.
VnG---------------Valentine	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.
VsB---------------Vetal	Severe: seepage.	Severe: piping.	Deep to water	Fast intake, soil blowing.	Soil blowing---	Favorable.
Vt----------------Vetal	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing---	Soil blowing---	Favorable.
WrB---------------Wildhorse	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave, excess sodium.	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Excess salt, excess sodium, droughty.

See footnote at end of table.

TABLE 17.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
WsB*:						
Wildhorse--------	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave, excess sodium.	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Excess salt, excess sodium, droughty.
Hoffland---------	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy.	Wetness, droughty.
WtB*:						
Wildhorse--------	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave, excess sodium.	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Excess salt, excess sodium, droughty.
Ipage------------	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Ac, AcB, AcC----- Alliance	0-8	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	20-40	2-15
	8-18	Silty clay loam, silt loam, clay loam.	CL	A-7, A-6	0	100	100	90-100	70-100	30-50	10-25
	18-49	Very fine sandy loam, silt loam, loam.	ML, CL-ML, SM, SC	A-4	0-5	85-100	85-100	70-100	40-90	15-30	NP-10
	49-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
An--------------- Almeria	0-8	Loamy fine sand	SM, SC-SM	A-2	0	100	100	50-75	15-30	15-20	NP-5
	8-60	Stratified sand, fine sand.	SM, SP-SM, SC-SM, SP	A-2, A-3	0	95-100	90-100	50-75	0-30	15-20	NP-5
Bc--------------- Bankard	0-7	Loamy fine sand	SM	A-2	0	95-100	90-100	50-90	15-35	<20	NP-5
	7-60	Stratified loamy fine sand to sand.	SM, SP-SM	A-2	0	95-100	75-100	60-80	10-25	<20	NP-5
Bd--------------- Beckton	0-5	Silt loam--------	CL	A-6	0	90-100	85-100	80-100	70-90	30-40	15-25
	5-8	Loam, fine sandy loam, silt loam.	SM, ML, CL-ML, SC-SM	A-4	0	80-100	75-95	50-70	35-60	20-30	NP-10
	8-18	Clay loam, silty clay loam, silty clay.	CL	A-7	0	90-100	75-100	70-95	60-85	40-50	20-30
	18-60	Silty clay, silty clay loam, silt loam.	CL	A-7, A-6	0	80-100	75-95	65-90	60-85	30-50	15-30
Bf--------------- Bolent	0-7	Loamy fine sand	SM, SP-SM, SC-SM	A-2, A-3	0	95-100	90-100	60-80	5-25	15-20	NP-5
	7-60	Stratified loamy fine sand to sand.	SM, SP, SP-SM, SC-SM	A-2, A-3, A-1	0	95-100	90-100	40-70	3-35	10-20	NP-5
Bh, BhB---------- Bridget	0-15	Very fine sandy loam.	ML, CL-ML, CL, SM	A-4	0	95-100	95-100	75-100	45-65	20-35	2-15
	15-60	Very fine sandy loam, silt loam, loam.	ML, CL-ML, CL	A-4	0	95-100	95-100	85-100	80-100	20-35	2-15
Bm--------------- Bridget	0-9	Loam-------------	ML, CL-ML, CL	A-4	0	95-100	95-100	75-100	55-75	20-35	2-15
	9-60	Very fine sandy loam, silt loam, loam.	ML, CL-ML, CL	A-4	0	95-100	95-100	85-100	80-100	20-35	2-15
BnB-------------- Bufton	0-6	Silty clay loam	CL, CH	A-7	0	100	95-100	80-100	80-95	40-60	20-30
	6-28	Clay loam, silty clay loam, silty clay.	CL, CH	A-7, A-6	0	100	95-100	80-100	80-95	35-60	15-30
	28-60	Silty clay loam, silt loam, silty clay.	CL, CH	A-7, A-6	0	100	95-100	80-100	80-95	30-60	15-30

TABLE 18.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
BnE-------------- Bufton	0-4	Silty clay loam	CL, CH	A-7	0	100	95-100	80-100	80-95	40-60	20-30
	4-24	Clay loam, silty clay loam, silty clay.	CL, CH	A-7, A-6	0	100	95-100	80-100	80-95	35-60	15-30
	24-60	Silty clay loam, silt loam, silty clay.	CL, CH	A-7, A-6	0	100	95-100	80-100	80-95	30-60	15-30
BoD*:											
Bufton----------	0-5	Silty clay loam	CL, CH	A-7	0	100	95-100	80-100	80-95	40-60	20-30
	5-23	Clay loam, silty clay loam, silty clay.	CL, CH	A-7, A-6	0	100	95-100	80-100	80-95	35-60	15-30
	23-60	Silty clay loam, silt loam, silty clay.	CL, CH	A-7, A-6	0	100	95-100	80-100	80-95	30-60	15-30
Orella----------	0-5	Silty clay loam	CH, CL	A-6, A-7	0	100	100	95-100	70-95	38-65	20-40
	5-16	Clay, clay loam, silty clay loam.	CH	A-7	0	100	100	90-100	75-95	50-70	30-50
	16-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
BsB, BsC, BsD---- Busher	0-11	Fine sandy loam	SM, ML, SC-SM, CL-ML	A-2, A-4	0	100	90-100	80-100	30-60	15-25	NP-5
	11-44	Loamy very fine sand, fine sandy loam, very fine sandy loam.	SM, ML, SC-SM, CL-ML	A-2, A-4	0	100	90-100	75-100	30-65	15-25	NP-5
	44-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
BvC*, BvF*:											
Busher----------	0-10	Fine sandy loam	SM, ML, SC-SM, CL-ML	A-2, A-4	0	100	90-100	80-100	30-60	15-25	NP-5
	10-44	Loamy very fine sand, fine sandy loam, very fine sandy loam.	SM, ML, SC-SM, CL-ML	A-2, A-4	0	100	90-100	75-100	30-65	15-25	NP-5
	44-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Tassel----------	0-3	Fine sandy loam	SM, ML, CL-ML, SC-SM	A-4, A-2	0	95-100	90-100	55-100	25-55	15-25	NP-8
	3-10	Fine sandy loam, sandy loam, loamy very fine sand.	ML, CL-ML, SM, SC-SM	A-4, A-2	0	95-100	80-100	65-95	25-60	15-25	NP-8
	10-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Ca--------------- Calamus	0-9	Loamy fine sand	SP-SM, SM, SC-SM	A-2, A-3	0	100	90-100	65-80	5-35	10-20	NP-5
	9-18	Fine sand, loamy fine sand, sand.	SM, SP-SM, SP	A-2, A-3	0	100	90-100	65-80	3-35	10-20	NP-5
	18-60	Stratified loamy sand to coarse sand.	SP, SP-SM, SM	A-2, A-3, A-1	0	95-100	75-100	30-90	3-35	10-20	NP-5

See footnote at end of table.

TABLE 18.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Cr-------------- Crowther	0-3	Loam-------------	CL	A-4, A-6	0	100	100	85-100	65-90	20-40	7-20
	3-28	Clay loam, loam, sandy clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	70-100	50-85	30-50	4-24
	28-60	Loamy fine sand, fine sand, sand.	SP-SM, SM	A-2, A-3	0	100	100	65-85	5-35	---	NP
Cs-------------- Crowther	0-7	Loam-------------	CL	A-4, A-6	0	100	100	85-100	65-90	20-40	7-20
	7-22	Clay loam, loam, sandy clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	70-100	50-85	30-50	4-24
	22-60	Loamy fine sand, fine sand, sand.	SP-SM, SM	A-2, A-3	0	100	100	65-85	5-35	---	NP
DuB, DuD--------- Dailey	0-15	Loamy fine sand	SM	A-2, A-4	0	100	100	70-95	20-40	<20	NP
	15-60	Loamy sand, fine sand, loamy fine sand.	SP-SM, SM	A-2, A-3	0	100	95-100	75-95	5-35	<20	NP
Dw-------------- Duroc	0-8	Loam-------------	CL, CL-ML	A-6, A-4	0	100	95-100	85-100	60-100	25-35	5-15
	8-50	Loam, silt loam	CL, CL-ML	A-6, A-4	0	100	95-100	85-100	70-100	25-35	5-15
	50-60	Loam, silt loam, very fine sandy loam.	CL, CL-ML	A-6, A-4	0	100	95-100	85-100	70-100	25-35	5-15
DwB------------- Duroc	0-6	Loam-------------	CL, CL-ML	A-6, A-4	0	100	95-100	85-100	60-100	25-35	5-15
	6-32	Loam, silt loam	CL, CL-ML	A-6, A-4	0	100	95-100	85-100	70-100	25-35	5-15
	32-60	Loam, silt loam, very fine sandy loam.	CL, CL-ML	A-6, A-4	0	100	95-100	85-100	70-100	25-35	5-15
Ec-------------- Els	0-7	Fine sand--------	SP-SM, SM	A-2, A-3	0	100	100	70-100	5-30	10-20	NP-5
	7-60	Fine sand, loamy sand, sand.	SP-SM, SM	A-2, A-3	0	95-100	95-100	70-100	5-35	10-20	NP-5
Ef*:											
Els-------------	0-7	Fine sand--------	SP-SM, SM	A-2, A-3	0	100	100	70-100	5-30	10-20	NP-5
	7-60	Fine sand, loamy sand, sand.	SP-SM, SM	A-2, A-3	0	95-100	95-100	70-100	5-35	10-20	NP-5
Hoffland--------	0-10	Fine sandy loam	SC, CL, CL-ML, SC-SM	A-4	0	100	100	70-95	40-55	15-25	4-10
	10-34	Fine sand, sand, loamy fine sand.	SP-SM, SM	A-2, A-3	0	100	100	51-90	5-35	10-20	NP-5
	34-60	Fine sand, sand	SP-SM, SM	A-2, A-3	0	100	100	51-90	5-35	10-20	NP-5
EgB*:											
Els-------------	0-8	Fine sand--------	SP-SM, SM	A-2, A-3	0	100	100	70-100	5-30	10-20	NP-5
	8-60	Fine sand, loamy sand, sand.	SP-SM, SM	A-2, A-3	0	95-100	95-100	70-100	5-35	10-20	NP-5
Ipage-----------	0-4	Fine sand--------	SM, SP-SM	A-2, A-3	0	100	100	50-100	5-30	---	NP
	4-60	Fine sand, loamy sand, sand.	SM, SP-SM, SP	A-2, A-3	0	100	95-100	50-100	2-30	---	NP
En*:											
Els-------------	0-9	Fine sand--------	SP-SM, SM	A-2, A-3	0	100	100	70-100	5-30	10-20	NP-5
	9-60	Fine sand, loamy sand, sand.	SP-SM, SM	A-2, A-3	0	95-100	95-100	70-100	5-35	10-20	NP-5

See footnote at end of table.

TABLE 18.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
En*:											
Tryon-----------	0-9	Loamy fine sand	SM, SP-SM	A-2	0	100	100	85-100	10-30	10-20	NP-5
	9-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SP	A-2, A-3	0	100	100	51-95	3-30	5-15	NP-5
Es--------------- Elsmere	0-17	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	100	70-100	5-35	10-20	NP-5
	17-60	Fine sand, sand	SP-SM, SM	A-2, A-3	0	100	100	60-100	5-30	5-15	NP-5
EuE*:											
Enning----------	0-3	Silty clay loam	ML, MH, CL, CH	A-7	0	95-100	95-100	90-100	85-100	40-55	15-25
	3-18	Silt loam, silty clay loam.	ML, MH, CL, CH	A-7	0	95-100	95-100	90-100	90-100	40-55	15-25
	18-60	Weathered bedrock	ML, MH, CL, CH	A-7	0	100	95-100	90-100	90-100	40-60	15-25
Minnequa--------	0-4	Silty clay loam	ML	A-4, A-6, A-7	0	100	100	95-100	85-95	30-45	5-15
	4-33	Silt loam, loam, silty clay loam.	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	90-100	80-90	25-35	5-15
	33-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
EvG*:											
Enning----------	0-3	Silty clay loam	ML, MH, CL, CH	A-7	0	95-100	95-100	90-100	85-100	40-55	15-25
	3-18	Silt loam, silty clay loam.	ML, MH, CL, CH	A-7	0	95-100	95-100	90-100	90-100	40-55	15-25
	18-60	Weathered bedrock	ML, MH, CL, CH	A-7	0	100	95-100	90-100	90-100	40-60	15-25
Rock outcrop----	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
EwG*:											
Epping----------	0-4	Very fine sandy loam.	ML, CL, CL-ML	A-4	0	100	95-100	85-100	65-95	15-30	2-10
	4-15	Loam, silt loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	90-100	75-100	60-95	15-35	2-15
	15-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Badland---------	0-60	Unweathered bedrock.	---	---	0	---	---	---	---	---	---
Fu--------------- Fluvaquents	0-3	Loamy sand-------	SM, SP-SM	A-2, A-3, A-4	0	100	100	50-70	5-40	<25	NP-5
	3-60	Variable---------	---	---	---	---	---	---	---	---	---
Gg--------------- Gannett	0-16	Loam-------------	ML, CL-ML, CL	A-4, A-6	0	100	100	95-100	50-65	25-35	3-13
	16-23	Fine sandy loam, sandy loam, loam.	SM, ML, CL, SC	A-2, A-4, A-6	0	100	100	95-100	30-65	15-35	NP-15
	23-60	Fine sand, loamy sand, sand.	SP-SM, SM	A-3, A-2	0	100	100	90-100	5-15	---	NP

See footnote at end of table.

TABLE 18.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Gh---------------- Gannett	0-19	Loam-------------	ML, CL-ML, CL	A-4, A-6	0	100	100	95-100	50-65	25-35	3-13
	19-29	Fine sandy loam, sandy loam, loam.	SM, ML, CL, SC	A-2, A-4, A-6	0	100	100	95-100	30-65	15-35	NP-15
	29-60	Fine sand, loamy sand, sand.	SP-SM, SM	A-3, A-2	0	100	100	90-100	5-15	15-20	NP-5
Hm---------------- Hoffland	0-11	Fine sandy loam	SC, CL, CL-ML, SC-SM	A-4	0	100	100	70-95	40-55	15-25	4-10
	11-41	Fine sand, sand, loamy fine sand.	SP-SM, SM	A-2, A-3	0	100	100	51-90	5-35	10-20	NP-5
	41-60	Fine sand, sand	SP-SM, SM	A-2, A-3	0	100	100	51-90	5-35	10-20	NP-5
Hn---------------- Hoffland	0-14	Fine sandy loam	SC, CL, CL-ML, SC-SM	A-4	0	100	100	70-95	40-55	15-25	4-10
	14-27	Fine sand, sand, loamy fine sand.	SP-SM, SM	A-2, A-3	0	100	100	51-90	5-35	10-20	NP-5
	27-60	Fine sand, sand	SP-SM, SM	A-2, A-3	0	100	100	51-90	5-35	10-20	NP-5
IpB--------------- Ipage	0-5	Fine sand---------	SM, SP-SM	A-2, A-3	0	100	100	50-100	5-30	---	NP
	5-60	Fine sand, loamy sand, sand.	SM, SP-SM, SP	A-2, A-3	0	100	95-100	50-100	2-30	---	NP
JgB, JgC, JgD---- Jayem	0-11	Fine sandy loam	SM	A-4, A-2	0	100	85-100	55-95	25-50	<25	NP-5
	11-24	Fine sandy loam, very fine sandy loam.	ML, SM	A-4, A-2	0	100	85-100	70-95	25-60	<25	NP-5
	24-60	Fine sandy loam, very fine sandy loam, loamy very fine sand.	ML, SM	A-4, A-2	0	100	85-100	70-95	25-60	<25	NP-5
Jo---------------- Johnstown	0-11	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	70-100	20-40	3-18
	11-34	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	80-95	30-50	15-30
	34-43	Silty clay loam, silt loam, very fine sandy loam.	CL, CL-ML	A-4, A-6	0	100	100	85-100	50-95	20-40	5-20
	43-60	Gravelly coarse sand, coarse sand, sand.	SM, SP-SM	A-1, A-2, A-3	0	60-100	50-95	25-70	5-15	5-15	NP-5
Kd, KdC, KdD----- Kadoka	0-7	Silt loam---------	ML, CL	A-4, A-6, A-7	0	100	95-100	90-100	70-100	30-45	5-20
	7-27	Silty clay loam, silt loam.	CL, ML	A-6, A-7	0	100	95-100	90-100	65-100	35-50	10-25
	27-32	Silt loam, loam	CL, ML	A-4, A-6, A-7	0-5	85-100	70-100	60-100	55-100	30-45	5-20
	32-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Ke, KeB, KeC----- Keith	0-9	Loam-------------	CL, ML, CL-ML	A-4	0	100	100	85-100	80-100	20-35	2-10
	9-28	Silt loam, silty clay loam, loam.	CL	A-6, A-7	0	100	100	95-100	80-100	30-45	10-25
	28-60	Silt loam, loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	80-100	20-35	2-12

See footnote at end of table.

TABLE 18.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Kg, KgB, KgC----- Keith	0-12	Loam-------------	CL, ML, CL-ML	A-4, A-6	0	100	95-100	85-95	60-75	20-40	3-17
	12-20	Clay loam, loam, silty clay loam.	CL, ML	A-6, A-7, A-4	0	100	95-100	85-100	60-80	30-45	5-20
	20-30	Loam, silt loam	CL, ML, CL-ML	A-4, A-6	0	100	95-100	85-95	60-75	20-40	3-17
	30-49	Loam-------------	CL, ML, CL-ML	A-4, A-6	0	100	95-100	85-95	60-75	20-40	3-17
	49-60	Gravelly coarse sand, gravelly loamy sand, gravelly sand.	SM, SP-SM	A-2, A-1, A-3	0	60-100	50-95	25-70	5-15	5-10	NP-5
Ky--------------- Keya	0-17	Loam-------------	ML, CL	A-4, A-6	0	100	100	90-100	70-90	30-40	5-15
	17-40	Clay loam, loam	CL	A-6, A-7	0	100	95-100	85-100	60-80	30-45	10-20
	40-60	Fine sandy loam, loam, clay loam.	ML, CL, SM, SC	A-4, A-6	0	100	95-100	70-85	40-80	25-40	3-15
La--------------- Las Animas	0-5	Loam-------------	CL-ML, CL	A-4	0	100	95-100	80-95	60-90	25-30	5-10
	5-60	Stratified very fine sandy loam to loamy fine sand.	SM, ML, SC-SM	A-2, A-4	0	95-100	90-100	55-90	25-55	20-25	NP-5
Lg--------------- Lodgepole	0-5	Silt loam--------	CL, CL-ML, ML	A-4, A-6	0	100	100	90-100	70-95	20-40	3-20
	5-32	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	90-100	85-95	50-65	25-40
	32-46	Silt loam, very fine sandy loam, loam.	CL, CL-ML, ML	A-4	0	100	100	90-100	60-90	20-35	3-10
	46-60	Sandy loam, fine sandy loam, loamy sand.	SM, ML	A-4, A-2	0	100	100	70-90	15-60	15-20	NP-5
Lu--------------- Lute	0-7	Loam-------------	ML, CL	A-4, A-6	0	100	100	70-100	50-70	30-40	5-15
	7-18	Sandy clay loam, fine sandy loam.	SM, SC, SC-SM	A-4, A-6	0	100	100	60-100	35-50	20-35	2-15
	18-60	Stratified very fine sandy loam to loamy sand.	SM, SC, SC-SM	A-1, A-2, A-4	0	100	100	45-100	15-50	15-30	NP-10
MbC-------------- Manvel	0-5	Silty clay loam	CL	A-6	0	100	95-100	95-100	80-90	35-40	10-15
	5-60	Silt loam, silty clay loam, loam.	CL, CL-ML	A-4, A-6	0	100	95-100	90-100	75-90	20-40	5-20
Mc--------------- Marlake	0-7	Fine sandy loam	SM, ML	A-4	0	100	100	70-85	40-55	<20	NP
	7-14	Fine sand, loamy sand, loamy fine sand.	SP-SM, SM	A-2, A-4, A-3	0	100	100	50-85	5-50	---	NP
	14-60	Sand, fine sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0	100	100	50-80	5-35	---	NP
Mk--------------- McCook	0-12	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	100	80-100	55-90	20-45	5-15
	12-60	Very fine sandy loam, silt loam, loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	80-100	50-100	15-45	NP-15

See footnote at end of table.

TABLE 18.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
Mm--------------- McCook	0-15	Loam-------------	ML, CL, CL-ML	A-4	0	100	100	85-100	60-90	20-35	2-10
	15-60	Very fine sandy loam, silt loam, loam.	ML, CL, CL-ML	A-4	0	100	100	95-100	80-100	15-25	NP-10
MxF*:											
Mitchell---------	0-4	Very fine sandy loam.	ML	A-4	0	100	100	85-100	65-95	20-35	NP-10
	4-60	Loam, very fine sandy loam, silt loam.	ML, CL-ML, CL	A-4, A-6	0	100	95-100	85-100	60-100	20-35	NP-15
Epping-----------	0-3	Very fine sandy loam.	ML, CL, CL-ML	A-4	0	100	95-100	85-100	65-95	15-30	2-10
	3-15	Loam, silt loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	90-100	75-100	60-95	15-35	2-15
	15-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
My--------------- Munjor	0-6	Fine sandy loam	SM, ML, CL-ML, SC-SM	A-4	0	95-100	90-100	65-95	40-65	15-30	NP-10
	6-60	Loam, sandy loam, loamy very fine sand.	SM, SC, ML, CL	A-4	0	95-100	95-100	85-100	35-65	15-20	NP-15
Mz--------------- Munjor	0-6	Fine sandy loam	SM, ML, CL-ML, SC-SM	A-4	0	95-100	90-100	65-95	40-65	15-30	NP-10
	6-60	Loam, sandy loam, loamy very fine sand.	SM, ML	A-4	0	95-100	95-100	85-100	35-65	15-20	NP-5
OhC*, OhD*, OhF*:											
Oglala-----------	0-8	Loam-------------	ML, CL	A-4, A-6	0	100	100	85-100	60-90	30-40	5-15
	8-58	Loam, silt loam, very fine sandy loam.	ML, CL	A-4, A-6	0	100	100	85-100	51-75	25-40	NP-15
	58-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Canyon-----------	0-5	Loam-------------	ML, CL, CL-ML, SM	A-4	0-5	90-100	75-100	50-95	40-75	15-30	2-10
	5-14	Very fine sandy loam, loam, gravelly loam.	ML, SM, SC, GM	A-4, A-6, A-2	0-5	60-100	50-100	40-95	30-75	20-40	NP-15
	14-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
On--------------- Onita	0-8	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	65-95	30-45	12-20
	8-32	Silty clay loam, clay loam, silty clay.	CL, CH, ML, MH	A-7	0	100	95-100	90-100	75-100	40-60	10-30
	32-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-6, A-7	0-5	95-100	95-100	85-100	65-100	30-55	10-30
OrF-------------- Orella	0-5	Silty clay loam	CH, CL	A-6, A-7	0	100	100	95-100	70-95	38-65	20-40
	5-16	Clay, clay loam, silty clay loam.	CH	A-7	0	100	100	90-100	75-95	50-70	30-50
	16-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 18.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
OvD--------------	0-6	Loamy fine sand	SM	A-2, A-4	0	100	95-100	65-100	15-40	10-20	NP-5
Orpha	6-12	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	75-100	70-90	5-35	10-20	NP-5
	12-60	Fine sand, sand	SM	A-2	0	100	75-100	75-85	5-30	10-20	NP-5
OwF*:											
Orpha-----------	0-6	Loamy fine sand	SM	A-2, A-4	0	100	95-100	65-100	15-40	10-20	NP-5
	6-11	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	75-100	70-90	5-35	10-20	NP-5
	11-60	Fine sand, sand	SM	A-2	0	100	75-100	75-85	5-30	10-20	NP-5
Niobrara--------	0-4	Loamy fine sand	SM	A-2	0	85-100	85-100	65-95	15-30	---	NP
	4-13	Sand, loamy fine sand, loamy sand.	SM, SP-SM	A-2, A-3	0	80-100	75-95	75-95	5-30	---	NP
	13-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
OxG*:											
Orpha-----------	0-6	Loamy fine sand	SM	A-2, A-4	0	100	95-100	65-100	15-40	10-20	NP-5
	6-32	Loamy fine sand, fine sand, sand.	SM	A-2	0	100	75-100	70-90	5-35	10-20	NP-5
	32-60	Fine sand, sand	SM	A-2	0	100	75-100	75-85	5-30	10-20	NP-5
Rock outcrop----	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
PoC, PoD---------	0-18	Very fine sandy loam.	SC-SM, SM, CL-ML, ML	A-4, A-6	0	100	95-100	75-100	45-65	15-30	NP-12
Ponderosa	18-30	Very fine sandy loam, loamy very fine sand.	SC-SM, SM, SC	A-4, A-2, A-6	0	95-100	75-100	65-100	30-50	15-30	NP-12
	30-60	Very fine sandy loam, loamy very fine sand.	SC-SM, SM, SC	A-4, A-2, A-6	0	85-100	75-100	65-100	30-50	15-30	NP-12
PtF*:											
Ponderosa-------	0-12	Very fine sandy loam.	SC-SM, SM, CL-ML, ML	A-4, A-6	0	100	95-100	75-100	45-65	15-30	NP-12
	12-27	Very fine sandy loam, loamy very fine sand.	SC-SM, SM, SC	A-4, A-2, A-6	0	95-100	75-100	65-100	30-50	15-30	NP-12
	27-60	Very fine sandy loam, loamy very fine sand.	SC-SM, SM, SC	A-4, A-2, A-6	0	85-100	75-100	65-100	30-50	15-30	NP-12
Tassel----------	0-3	Very fine sandy loam.	SM, ML, CL-ML, SC-SM	A-4	0	95-100	90-100	75-100	40-60	15-25	NP-8
	3-15	Fine sandy loam, sandy loam, loamy very fine sand.	ML, CL-ML, SM, SC-SM	A-4, A-2	0	95-100	80-100	65-95	25-60	15-25	NP-8
	15-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 18.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Frag-ments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
PtF*:											
Vetal-----------	0-7	Very fine sandy loam.	CL, ML, SM, SC	A-4, A-6, A-2	0	100	95-100	90-100	30-55	20-35	NP-12
	7-42	Sandy loam, fine sandy loam, very fine sandy loam.	SM, ML, CL-ML, SC-SM	A-4, A-2	0	100	95-100	60-100	30-65	20-30	NP-10
	42-60	Sandy loam, fine sandy loam, very fine sandy loam.	SM, ML, CL-ML, SC-SM	A-4, A-2	0	100	90-100	60-100	30-65	20-30	NP-10
RoB-------------- Rosebud	0-9	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	95-100	90-100	80-100	55-90	24-34	3-12
	9-17	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	80-100	60-95	30-50	12-26
	17-32	Sandy loam, very fine sandy loam, loam.	SM, ML, CL-ML, SC-SM	A-4, A-6, A-2	0-5	95-100	80-100	60-100	30-90	20-40	2-12
	32-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
SnB, SnC, SnD---- Satanta	0-14	Fine sandy loam	SM, ML, CL-ML, SC-SM	A-4	0	100	95-100	70-85	40-55	<25	NP-5
	14-35	Loam, clay loam, sandy clay loam.	SC, CL	A-7, A-6	0	100	95-100	75-100	45-75	30-45	10-20
	35-60	Fine sandy loam, very fine sandy loam.	ML, SM	A-4	0	100	95-100	70-95	40-60	20-30	NP-5
SsD*:											
Satanta---------	0-10	Fine sandy loam	SM, ML, CL-ML, SC-SM	A-4	0	100	95-100	70-85	40-55	<25	NP-5
	10-33	Loam, clay loam, sandy clay loam.	SC, CL	A-7, A-6	0	100	95-100	75-100	45-75	30-45	10-20
	33-60	Fine sandy loam, very fine sandy loam.	ML, SM	A-4	0	100	95-100	70-95	40-60	20-30	NP-5
Canyon----------	0-6	Loam------------	ML, CL, CL-ML, SM	A-4	0-5	90-100	75-100	50-95	40-75	15-30	2-10
	6-14	Very fine sandy loam, loam, gravelly loam.	ML, SM, SC, GM	A-4, A-6, A-2	0-5	60-100	50-100	40-95	30-75	20-40	NP-15
	14-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
SsE*:											
Satanta---------	0-9	Fine sandy loam	SM, ML, CL-ML, SC-SM	A-4	0	100	95-100	70-85	40-55	<25	NP-5
	9-32	Loam, clay loam, sandy clay loam.	SC, CL	A-7, A-6	0	100	95-100	75-100	45-75	30-45	10-20
	32-50	Fine sandy loam, very fine sandy loam.	ML, SM	A-4	0	100	95-100	70-95	40-60	20-30	NP-5
	50-60	Loamy fine sand	SM	A-2-4, A-1-b	0	100	90-100	45-75	15-30	<25	NP
Canyon----------	0-6	Loam------------	ML, CL, CL-ML, SM	A-4	0-5	90-100	75-100	50-95	40-75	15-30	2-10
	6-14	Very fine sandy loam, loam, gravelly loam.	ML, SM, SC, GM	A-4, A-6, A-2	0-5	60-100	50-100	40-95	30-75	20-40	NP-15
	14-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 18.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
TfG*:											
Tassel----------	0-9	Very fine sandy loam.	SM, ML, CL-ML, SC-SM	A-4	0	95-100	90-100	75-100	40-60	15-25	NP-8
	9-16	Fine sandy loam, sandy loam, loamy very fine sand.	ML, CL-ML, SM, SC-SM	A-4, A-2	0	95-100	80-100	65-95	25-60	15-25	NP-8
	16-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Rock outcrop----	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
TgG*:											
Tassel----------	0-4	Very fine sandy loam.	SM, ML, CL-ML, SC-SM	A-4	0	95-100	90-100	75-100	40-60	15-25	NP-8
	4-14	Fine sandy loam, sandy loam, loamy very fine sand.	ML, CL-ML, SM, SC-SM	A-4, A-2	0	95-100	80-100	65-95	25-60	15-25	NP-8
	14-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Ponderosa-------	0-9	Very fine sandy loam.	SC-SM, SM, CL-ML, ML	A-4, A-6	0	100	95-100	75-100	45-65	15-30	NP-12
	9-23	Very fine sandy loam, loamy very fine sand.	SC-SM, SM, SC	A-4, A-2, A-6	0	95-100	75-100	65-100	30-50	15-30	NP-12
	23-60	Very fine sandy loam, loamy very fine sand.	SC-SM, SM, SC	A-4, A-2, A-6	0	85-100	75-100	65-100	30-50	15-30	NP-12
Rock outcrop----	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
ThB, ThC, ThD---- Thirtynine	0-8	Loam------------	ML, CL-ML, CL	A-4, A-6	0	100	95-100	75-100	70-90	20-35	2-20
	8-21	Silt loam, silty clay loam, loam.	CL-ML, CL	A-4, A-6	0	100	95-100	90-100	75-95	25-35	5-15
	21-60	Silt loam, loam, very fine sandy loam.	ML, CL-ML	A-4	0	95-100	85-100	85-100	70-90	15-25	NP-5
To--------------- Tryon	0-6	Fine sandy loam	SM, SC-SM	A-2, A-4	0	100	100	70-100	30-45	15-25	NP-6
	6-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SP	A-2, A-3	0	100	100	51-95	3-30	5-15	NP-5
Tp--------------- Tryon	0-5	Fine sandy loam	SC-SM, SM	A-2, A-4	0	100	100	70-100	30-45	15-25	NP-6
	5-60	Fine sand, loamy sand, loamy fine sand.	SP-SM, SM	A-2, A-3	0	100	100	50-90	5-30	5-15	NP-5
TtB, TtD--------- Tuthill	0-11	Loamy fine sand	SM, SC, SC-SM	A-2	0	100	100	50-75	15-30	15-30	NP-10
	11-30	Sandy clay loam, fine sandy loam, loam.	SC-SM, SC, CL-ML, CL	A-4, A-6, A-7	0	100	100	70-95	35-55	15-45	2-20
	30-60	Fine sand, loamy fine sand.	SP-SM, SM, SC-SM	A-2, A-3, A-1	0	100	95-100	45-70	5-30	15-20	NP-5

See footnote at end of table.

TABLE 18.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
TwB, TwC, TwD----Tuthill	0-9	Fine sandy loam	SM	A-4, A-2	0	100	100	85-100	30-50	20-35	NP-10
	9-21	Sandy clay loam, sandy loam, clay loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0	100	100	70-100	35-70	25-40	5-15
	21-60	Loamy sand, loamy fine sand, fine sand.	SM, SC-SM, SP-SM	A-2	0	100	95-100	50-100	10-30	15-25	NP-5
VaB, VaD, VaE----Valent	0-4	Fine sand--------	SP-SM, SM	A-2, A-3	0	100	100	60-70	5-20	---	NP
	4-60	Fine sand, loamy fine sand, sand.	SM, SP-SM	A-2	0	100	95-100	75-90	10-30	---	NP
VaF*:											
Valent, rolling-	0-4	Fine sand--------	SP-SM, SM	A-2, A-3	0	100	100	60-70	5-20	---	NP
	4-60	Fine sand, loamy fine sand, sand.	SM, SP-SM	A-2	0	100	95-100	75-90	10-30	---	NP
Valent, hilly---	0-4	Fine sand--------	SP-SM, SM	A-2, A-3	0	100	100	60-70	5-20	---	NP
	4-60	Fine sand, loamy fine sand, sand.	SM, SP-SM	A-2	0	100	95-100	75-90	10-30	---	NP
VaG--------------Valent	0-4	Fine sand--------	SP-SM, SM	A-2, A-3	0	100	100	60-70	5-20	---	NP
	4-60	Fine sand, loamy fine sand, sand.	SM, SP-SM	A-2	0	100	95-100	75-90	10-30	---	NP
VeB, VeD---------Valent	0-5	Loamy fine sand	SM, SP-SM	A-2	0	100	100	70-95	10-30	<25	NP-5
	5-60	Fine sand, loamy fine sand, sand.	SM, SP-SM	A-2	0	100	95-100	75-90	10-30	---	NP
VnD, VnE---------Valentine	0-6	Fine sand--------	SM, SP-SM, SP	A-2, A-3	0	100	100	70-100	2-25	15-20	NP-5
	6-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-20	15-20	NP-5
VnF*:											
Valentine, rolling--------	0-6	Fine sand--------	SM, SP-SM, SP	A-2, A-3	0	100	100	70-100	2-25	15-20	NP-5
	6-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-20	15-20	NP-5
Valentine, hilly	0-6	Fine sand--------	SM, SP-SM, SP	A-2, A-3	0	100	100	70-100	2-25	15-20	NP-5
	6-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-20	15-20	NP-5
VnG--------------Valentine	0-6	Fine sand--------	SM, SP-SM, SP	A-2, A-3	0	100	100	70-100	2-25	15-20	NP-5
	6-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-20	15-20	NP-5
VsB--------------Vetal	0-7	Loamy fine sand	SM, SC-SM	A-2	0	100	100	85-100	15-35	15-25	NP-5
	7-40	Fine sandy loam, very fine sandy loam, sandy loam.	SM, ML	A-4, A-2	0	100	100	60-95	30-65	20-30	NP-7
	40-60	Loamy fine sand, fine sand, sand.	SM, SC-SM	A-2	0	100	90-100	85-100	15-35	15-25	NP-5

See footnote at end of table.

TABLE 18.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
Vt--------------- Vetal	0-7	Fine sandy loam	SM, ML, CL-ML, SC-SM	A-4, A-2	0	100	95-100	60-100	30-55	20-30	NP-10
	7-43	Sandy loam, fine sandy loam, very fine sandy loam.	SM, ML, CL-ML, SC-SM	A-4, A-2	0	100	95-100	60-100	30-65	20-30	NP-10
	43-60	Loamy fine sand, fine sand, sand.	SM, SC-SM	A-2	0	100	90-100	85-100	15-35	15-25	NP-5
WrB-------------- Wildhorse	0-5	Fine sand--------	SM, SP-SM	A-2, A-3, A-4	0	100	100	50-100	5-40	10-20	NP-5
	5-60	Fine sand, loamy fine sand, sand.	SM, SP-SM	A-2, A-3	0	100	100	50-100	5-35	10-20	NP-5
WsB*: Wildhorse-------	0-6	Fine sand--------	SM, SP-SM	A-2, A-3, A-4	0	100	100	50-100	5-40	10-20	NP-5
	6-60	Fine sand, loamy fine sand, sand.	SM, SP-SM	A-2, A-3	0	100	100	50-100	5-35	10-20	NP-5
Hoffland--------	0-11	Fine sandy loam	SC, CL, CL-ML, SC-SM	A-4	0	100	100	70-95	40-55	15-25	4-10
	11-60	Fine sand, sand, loamy fine sand.	SP-SM, SM	A-2, A-3	0	100	100	51-90	5-35	10-20	NP-5
WtB*: Wildhorse-------	0-6	Fine sand--------	SM, SP-SM	A-2, A-3, A-4	0	100	100	50-100	5-40	10-20	NP-5
	6-60	Fine sand, loamy fine sand, sand.	SM, SP-SM	A-2, A-3	0	100	100	50-100	5-35	10-20	NP-5
Ipage-----------	0-6	Fine sand--------	SM, SP-SM	A-2, A-3	0	100	100	50-100	5-30	---	NP
	6-60	Fine sand, loamy sand, sand.	SM, SP-SM, SP	A-2, A-3	0	100	95-100	50-100	2-30	---	NP

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 19.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Ac, AcB, AcC	0-8	15-20	1.25-1.45	0.6-2.0	0.20-0.22	6.6-7.8	0-0	Low	0.28	5	5	2-4
Alliance	8-18	25-35	1.15-1.30	0.2-2.0	0.18-0.20	6.6-7.8	0-0	Moderate	0.43			
	18-49	10-20	1.30-1.60	0.6-2.0	0.15-0.18	7.4-8.4	0-0	Low	0.24			
	49-60	---	---	0.2-0.6	---	---	---	---	---			
An	0-8	3-10	1.35-1.55	6.0-20	0.10-0.12	6.1-8.4	0-4	Low	0.17	5	8	.5-4
Almeria	8-60	1-10	1.55-1.80	6.0-20	0.05-0.12	5.6-7.3	0-4	Low	0.15			
Bc	0-7	2-10	1.80-1.95	6.0-20	0.10-0.15	7.4-8.4	<2	Low	0.17	5	2	.5-2
Bankard	7-60	0-10	1.85-2.00	6.0-20	0.07-0.15	7.4-8.4	<2	Low	0.17			
Bd	0-5	20-40	1.30-1.40	0.2-0.6	0.10-0.13	6.1-8.4	<8	Moderate	0.32	2	7	1-3
Beckton	5-8	10-20	1.40-1.45	0.6-2.0	0.10-0.13	6.6-9.0	<8	Low	0.20			
	8-18	35-50	1.40-1.50	0.06-0.2	0.12-0.15	7.4-9.0	>4	High	0.28			
	18-60	15-50	1.30-1.45	<0.2	0.10-0.13	>7.8	>4	High	0.28			
Bf	0-7	3-10	1.40-1.60	6.0-20	0.10-0.12	7.4-8.4	0-0	Low	0.17	5	2	.5-1
Bolent	7-60	1-10	1.50-1.80	6.0-20	0.05-0.10	6.6-8.4	0-0	Low	0.15			
Bh, BhB	0-15	5-18	1.30-1.50	0.6-2.0	0.16-0.20	6.6-7.8	0-0	Low	0.32	5	3	1-3
Bridget	15-60	5-18	1.40-1.60	0.6-2.0	0.16-0.24	7.4-8.4	0-0	Low	0.43			
Bm	0-9	10-20	1.25-1.45	0.6-2.0	0.17-0.22	6.6-7.8	0-0	Low	0.28	5	5	1-3
Bridget	9-60	5-18	1.40-1.60	0.6-2.0	0.16-0.24	7.4-8.4	0-0	Low	0.43			
BnB	0-6	30-40	1.20-1.40	0.2-0.6	0.18-0.23	6.6-8.4	0-0	High	0.43	5	4L	1-3
Bufton	6-28	35-45	1.20-1.40	0.06-0.6	0.12-0.20	7.4-9.0	0-4	High	0.37			
	28-60	25-45	1.20-1.30	0.06-0.6	0.10-0.18	7.9-9.0	0-4	High	0.37			
BnE	0-4	30-40	1.20-1.40	0.2-0.6	0.18-0.23	6.6-8.4	0-0	High	0.43	5	4L	1-3
Bufton	4-24	35-45	1.20-1.40	0.06-0.6	0.12-0.20	7.4-9.0	0-4	High	0.37			
	24-60	25-45	1.20-1.30	0.06-0.6	0.10-0.18	7.9-9.0	0-4	High	0.37			
BoD*:												
Bufton	0-5	30-40	1.20-1.40	0.2-0.6	0.18-0.23	6.6-8.4	0-0	High	0.43	5	4L	1-3
	5-23	35-45	1.20-1.40	0.06-0.6	0.12-0.20	7.4-9.0	0-4	High	0.37			
	23-60	25-45	1.20-1.30	0.06-0.6	0.10-0.18	7.9-9.0	0-4	High	0.37			
Orella	0-5	27-40	1.00-1.20	0.2-0.6	0.12-0.14	7.4-8.4	0-4	High	0.37	2	4L	.5-1
	5-16	38-65	1.00-1.20	0.00-0.06	0.09-0.11	7.4-9.0	4-16	High	0.32			
	16-60	---	---	0.06-0.2	---	---	---	---	---			
BsB, BsC, BsD	0-11	5-15	1.30-1.50	2.0-6.0	0.15-0.18	6.1-7.8	0-0	Low	0.20	5	3	1-3
Busher	11-44	5-12	1.40-1.60	2.0-6.0	0.13-0.19	6.6-8.4	0-0	Low	0.28			
	44-60	---	---	0.2-0.6	---	---	---	---	---			
BvC*, BvF*:												
Busher	0-10	5-15	1.30-1.50	2.0-6.0	0.15-0.18	6.1-7.8	0-0	Low	0.20	5	3	1-3
	10-44	5-12	1.40-1.60	2.0-6.0	0.13-0.19	6.6-8.4	0-0	Low	0.28			
	44-60	---	---	0.2-0.6	---	---	---	---	---			
Tassel	0-3	5-12	1.30-1.50	2.0-6.0	0.12-0.16	7.4-8.4	0-0	Low	0.24	2	3	1-3
	3-10	5-12	1.40-1.70	2.0-6.0	0.12-0.18	7.4-8.4	0-0	Low	0.28			
	10-60	---	---	0.2-0.6	---	---	---	---	---			

See footnote at end of table.

TABLE 19.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Ca---------------	0-9	1-10	1.50-1.60	6.0-20	0.06-0.11	5.6-7.8	0-0	Low--------	0.17	5	2	.5-1
Calamus	9-18	3-10	1.50-1.60	6.0-20	0.06-0.11	6.1-7.8	0-0	Low--------	0.17			
	18-60	1-10	1.50-1.70	6.0-20	0.02-0.11	6.1-7.8	0-0	Low--------	0.15			
Cr---------------	0-3	15-35	1.20-1.40	0.6-6.0	0.17-0.23	7.4-8.4	<2	Moderate	0.24	5	8	8-16
Crowther	3-28	20-40	1.20-1.50	0.6-6.0	0.15-0.19	7.9-8.4	<2	Moderate	0.32			
	28-60	1-10	1.50-1.70	6.0-20	0.06-0.11	6.6-8.4	<2	Low--------	0.17			
Cs---------------	0-7	15-35	1.20-1.40	0.6-6.0	0.17-0.23	7.4-8.4	<2	Moderate	0.24	5	8	8-16
Crowther	7-22	20-40	1.20-1.50	0.6-6.0	0.15-0.19	7.9-8.4	<2	Moderate	0.32			
	22-60	1-10	1.50-1.70	6.0-20	0.06-0.11	6.6-8.4	<2	Low--------	0.17			
DuB, DuD---------	0-15	2-5	1.70-1.85	6.0-20	0.07-0.12	6.6-7.3	<2	Low--------	0.17	5	2	1-3
Dailey	15-60	2-5	1.75-1.95	6.0-20	0.04-0.07	6.6-8.4	<2	Low--------	0.10			
Dw---------------	0-8	15-20	1.20-1.45	0.6-2.0	0.12-0.22	6.6-7.8	0-0	Moderate	0.28	5	5	1-3
Duroc	8-50	18-27	1.40-1.65	0.6-2.0	0.12-0.20	6.6-7.8	0-0	Moderate	0.43			
	50-60	18-27	1.40-1.65	0.6-2.0	0.12-0.20	7.9-9.0	0-2	Moderate	0.43			
DwB--------------	0-6	15-20	1.20-1.45	0.6-2.0	0.12-0.22	6.6-7.8	0-0	Moderate	0.28	5	5	1-3
Duroc	6-32	18-27	1.40-1.65	0.6-2.0	0.12-0.20	6.6-7.8	0-0	Moderate	0.43			
	32-60	18-27	1.40-1.65	0.6-2.0	0.12-0.20	7.9-9.0	0-2	Moderate	0.43			
Ec---------------	0-7	1-8	1.60-1.70	6.0-20	0.07-0.09	7.4-8.4	0-2	Low--------	0.15	5	1	.5-3
Els	7-60	1-10	1.50-1.70	6.0-20	0.05-0.08	7.4-8.4	0-2	Low--------	0.15			
Ef*:												
Els--------------	0-7	1-8	1.60-1.70	6.0-20	0.07-0.09	7.4-8.4	0-2	Low--------	0.15	5	1	.5-3
	7-60	1-10	1.50-1.70	6.0-20	0.05-0.08	7.4-8.4	0-2	Low--------	0.15			
Hoffland---------	0-10	15-20	1.20-1.50	2.0-6.0	0.16-0.19	7.9-8.4	0-2	Low--------	0.20	5	8	4-12
	10-34	1-10	1.40-1.70	6.0-20	0.06-0.11	6.6-8.4	0-0	Low--------	0.15			
	34-60	1-10	1.40-1.70	6.0-20	0.06-0.11	6.6-7.8	0-0	Low--------	0.15			
EgB*:												
Els--------------	0-8	1-8	1.60-1.70	6.0-20	0.07-0.09	7.4-8.4	0-2	Low--------	0.15	5	1	.5-3
	8-60	1-10	1.50-1.70	6.0-20	0.05-0.08	7.4-8.4	0-2	Low--------	0.15			
Ipage------------	0-4	1-5	1.40-1.50	6.0-20	0.07-0.09	5.1-7.3	0-0	Low--------	0.15	5	1	.5-1
	4-60	1-8	1.50-1.60	6.0-20	0.04-0.10	5.1-7.3	0-0	Low--------	0.15			
En*:												
Els--------------	0-9	1-8	1.60-1.70	6.0-20	0.07-0.09	7.4-8.4	0-2	Low--------	0.15	5	1	.5-3
	9-60	1-10	1.50-1.70	6.0-20	0.05-0.08	7.4-8.4	0-2	Low--------	0.15			
Tryon------------	0-9	3-10	1.40-1.60	6.0-20	0.10-0.12	5.6-8.4	0-0	Low--------	0.17	5	8	4-8
	9-60	1-7	1.50-1.70	6.0-20	0.06-0.08	5.6-7.8	0-0	Low--------	0.17			
Es---------------	0-17	3-10	1.55-1.70	6.0-20	0.10-0.12	5.6-7.3	0-0	Low--------	0.17	5	2	1-3
Elsmere	17-60	0-5	1.50-1.60	6.0-20	0.05-0.07	5.6-7.8	0-0	Low--------	0.15			
EuE*:												
Enning-----------	0-3	27-30	1.15-1.25	0.6-2.0	0.14-0.17	6.6-8.4	<2	Low--------	0.43	2	4L	1-3
	3-18	18-35	1.20-1.35	0.6-2.0	0.14-0.17	7.4-8.4	<2	Low--------	0.43			
	18-60	---	---	0.06-0.6	---	7.4-8.4	---	-----------	----			
Minnequa---------	0-4	28-35	1.15-1.30	0.2-0.6	0.17-0.21	7.4-8.4	0-2	Low--------	0.32	2	4L	.5-2
	4-33	18-35	1.15-1.40	0.2-2.0	0.14-0.18	7.4-9.0	0-8	Low--------	0.37			
	33-60	---	---	0.00-2.0	---	---	---	-----------	----			

See footnote at end of table.

TABLE 19.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
EvG*:												
Enning----------	0-3	27-30	1.15-1.25	0.6-2.0	0.14-0.17	6.6-8.4	<2	Low--------	0.43	2	4L	1-3
	3-18	18-35	1.20-1.35	0.6-2.0	0.14-0.17	7.4-8.4	<2	Low--------	0.43			
	18-60	---	---	0.06-0.6	---	7.4-8.4	---	-----------	----			
Rock outcrop----	0-60	---	---	---	---	---	<2	-----------	----	---	8	---
EwG*:												
Epping----------	0-4	10-20	1.25-1.45	0.6-2.0	0.12-0.20	6.6-8.4	<2	Low--------	0.43	2	3	.5-2
	4-15	10-20	1.20-1.45	0.6-2.0	0.12-0.20	7.4-8.4	<2	Low--------	0.43			
	15-60	---	---	0.06-0.2	---	---	---	-----------	----			
Badland---------	0-60	---	---	---	---	---	<2	-----------	----	---	8	---
Fu--------------- Fluvaquents	0-3	1-18	1.30-1.80	6.0-20	0.07-0.13	6.6-8.4	<2	Low--------	0.17	5	8	2-8
	3-60	---	---	0.06-20	---	---	---	-----------	----			
Gg--------------- Gannett	0-16	5-18	1.20-1.50	2.0-6.0	0.15-0.19	6.6-8.4	0-0	Low--------	0.24	4	8	4-12
	16-23	5-18	1.20-1.50	2.0-6.0	0.13-0.19	6.6-8.4	0-0	Low--------	0.20			
	23-60	2-7	1.50-1.70	6.0-20	0.05-0.07	6.6-8.4	0-0	Low--------	0.15			
Gh--------------- Gannett	0-19	5-18	1.20-1.50	2.0-6.0	0.15-0.19	6.6-8.4	0-0	Low--------	0.24	4	8	4-12
	19-29	5-18	1.20-1.50	2.0-6.0	0.13-0.19	6.6-8.4	0-0	Low--------	0.20			
	29-60	2-7	1.40-1.70	6.0-20	0.05-0.07	6.6-8.4	0-0	Low--------	0.15			
Hm--------------- Hoffland	0-11	15-20	1.20-1.50	2.0-6.0	0.16-0.19	7.9-8.4	0-2	Low--------	0.20	5	8	4-12
	11-41	1-10	1.40-1.70	6.0-20	0.06-0.11	6.6-8.4	0-0	Low--------	0.15			
	41-60	1-10	1.40-1.70	6.0-20	0.06-0.11	6.6-7.8	0-0	Low--------	0.15			
Hn--------------- Hoffland	0-14	15-20	1.20-1.50	2.0-6.0	0.16-0.19	7.9-8.4	0-2	Low--------	0.20	5	8	4-12
	14-27	1-10	1.40-1.70	6.0-20	0.06-0.11	6.6-8.4	0-0	Low--------	0.15			
	27-60	1-10	1.40-1.70	6.0-20	0.06-0.11	6.6-7.8	0-0	Low--------	0.15			
IpB-------------- Ipage	0-5	1-5	1.40-1.50	6.0-20	0.07-0.09	5.1-7.3	0-0	Low--------	0.15	5	1	.5-1
	5-60	1-8	1.50-1.60	6.0-20	0.04-0.10	5.1-7.3	0-0	Low--------	0.15			
JgB, JgC, JgD---- Jayem	0-11	5-15	1.20-1.35	2.0-6.0	0.13-0.15	6.6-7.8	<2	Low--------	0.20	5	3	1-3
	11-24	5-18	1.30-1.45	2.0-6.0	0.13-0.15	6.6-7.8	<2	Low--------	0.32			
	24-60	5-18	1.30-1.50	2.0-6.0	0.13-0.15	6.6-7.8	<2	Low--------	0.32			
Jo--------------- Johnstown	0-11	12-22	1.30-1.50	0.6-2.0	0.20-0.24	5.6-7.3	0-0	Moderate	0.28	5	5	1-3
	11-34	27-35	1.40-1.50	0.6-2.0	0.15-0.20	6.1-7.8	0-0	Moderate	0.37			
	34-43	15-32	1.30-1.50	0.6-2.0	0.17-0.22	6.6-8.4	0-0	Moderate	0.43			
	43-60	0-5	1.50-1.70	6.0-20	0.02-0.04	6.6-7.8	0-0	Low--------	0.05			
Kd, KdC, KdD----- Kadoka	0-7	20-27	1.20-1.30	0.6-2.0	0.19-0.22	6.6-7.8	0-2	Low--------	0.32	4	6	2-4
	7-27	25-35	1.20-1.35	0.6-2.0	0.18-0.21	6.6-7.8	0-2	Moderate	0.43			
	27-32	20-27	1.20-1.35	0.6-2.0	0.16-0.19	7.4-8.4	0-2	Low--------	0.43			
	32-60	---	---	0.06-0.2	---	---	---	-----------	----			
Ke, KeB, KeC----- Keith	0-9	14-20	1.25-1.45	0.6-2.0	0.20-0.23	6.1-7.3	0-0	Low--------	0.28	5	5	1-3
	9-28	20-35	1.10-1.20	0.6-2.0	0.18-0.22	6.6-7.3	0-0	Moderate	0.43			
	28-60	8-20	1.30-1.40	0.6-2.0	0.20-0.22	7.4-8.4	0-0	Low--------	0.43			
Kg, KgB, KgC----- Keith	0-12	12-22	1.25-1.45	0.6-2.0	0.20-0.22	6.6-7.8	0-0	Low--------	0.28	5	5	1-3
	12-20	18-35	1.30-1.50	0.6-2.0	0.17-0.19	6.6-7.8	0-0	Moderate	0.37			
	20-30	18-27	1.45-1.65	0.6-2.0	0.17-0.19	7.4-8.4	0-0	Low--------	0.37			
	30-49	12-22	1.45-1.65	0.6-2.0	0.17-0.19	7.4-8.4	0-0	Low--------	0.37			
	49-60	2-5	1.65-1.85	>20	0.02-0.04	7.4-8.4	0-0	Low--------	0.05			

See footnote at end of table.

TABLE 19.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Ky-------------- Keya	0-17	20-26	1.15-1.30	0.6-2.0	0.19-0.22	6.1-7.3	0-2	Moderate	0.28	5	6	2-4
	17-40	24-34	1.20-1.40	0.6-2.0	0.16-0.22	6.6-7.8	0-2	Moderate	0.28			
	40-60	10-30	1.35-1.50	0.6-2.0	0.12-0.20	7.4-8.4	0-2	Low-------	0.32			
La-------------- Las Animas	0-5	15-25	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	0-4	Low-------	0.32	5	4L	.5-2
	5-60	8-18	1.50-1.70	2.0-6.0	0.12-0.18	7.4-8.4	0-2	Low-------	0.28			
Lg-------------- Lodgepole	0-5	16-25	1.20-1.40	0.6-2.0	0.22-0.24	6.1-7.8	0-0	Low-------	0.37	3	6	2-4
	5-32	35-50	1.25-1.50	0.00-0.06	0.13-0.18	6.1-7.8	0-0	High------	0.28			
	32-46	8-27	1.30-1.50	0.6-2.0	0.22-0.24	6.6-8.4	0-0	Low-------	0.43			
	46-60	5-20	1.40-1.50	2.0-6.0	0.10-0.18	6.6-8.4	0-0	Low-------	0.28			
Lu-------------- Lute	0-7	10-25	1.20-1.35	0.6-2.0	0.18-0.20	6.6-8.4	0-8	Low-------	0.32	3	6	1-3
	7-18	18-26	1.25-1.35	0.06-0.2	0.09-0.15	7.4-9.8	4-16	Low-------	0.32			
	18-60	5-15	1.20-1.50	0.6-6.0	0.05-0.14	7.9-9.8	4-16	Low-------	0.28			
MbC------------- Manvel	0-5	28-35	1.15-1.30	0.2-0.6	0.16-0.18	7.9-8.4	0-2	Moderate	0.32	5	4L	.5-2
	5-60	18-35	1.25-1.40	0.2-0.6	0.14-0.18	7.9-8.4	2-4	Low-------	0.43			
Mc-------------- Marlake	0-7	5-15	1.40-1.50	2.0-6.0	0.16-0.18	6.6-8.4	<2	Low-------	0.20	2	8	4-8
	7-14	3-8	1.50-1.60	6.0-20	0.06-0.11	6.6-8.4	<2	Low-------	0.17			
	14-60	0-5	1.50-1.60	6.0-20	0.05-0.07	6.6-8.4	<2	Low-------	0.17			
Mk-------------- McCook	0-12	10-27	1.30-1.50	0.6-2.0	0.19-0.22	6.6-8.4	0-0	Moderate	0.28	5	4L	2-4
	12-60	10-18	1.20-1.50	0.6-2.0	0.16-0.20	7.4-8.4	0-0	Low-------	0.43			
Mm-------------- McCook	0-15	15-20	1.20-1.40	0.6-2.0	0.20-0.24	7.4-8.4	0-0	Low-------	0.28	5	4L	2-4
	15-60	10-18	1.30-1.45	0.6-2.0	0.17-0.20	7.4-8.4	0-0	Low-------	0.43			
MxF*:												
Mitchell--------	0-4	10-20	1.30-1.60	0.6-2.0	0.16-0.20	7.4-8.4	0-0	Low-------	0.43	5	3	.5-2
	4-60	8-18	1.20-1.60	0.6-2.0	0.16-0.22	7.4-8.4	0-0	Low-------	0.43			
Epping----------	0-3	10-20	1.25-1.45	0.6-2.0	0.12-0.20	6.6-8.4	<2	Low-------	0.43	2	3	.5-2
	3-15	10-20	1.20-1.45	0.6-2.0	0.12-0.20	7.4-8.4	<2	Low-------	0.43			
	15-60	---	---	0.06-0.2	---	---	---	----------	----			
My, Mz---------- Munjor	0-6	7-20	1.30-1.40	2.0-6.0	0.13-0.18	7.4-8.4	<2	Low-------	0.24	5	3	.5-1
	6-60	7-18	1.30-1.40	2.0-6.0	0.13-0.18	7.4-8.4	<2	Low-------	0.24			
OhC*, OhD*, OhF*:												
Oglala----------	0-8	10-18	1.20-1.30	0.6-2.0	0.18-0.20	6.1-7.8	0-2	Low-------	0.28	5	5	1-4
	8-58	5-18	1.25-1.40	0.6-2.0	0.16-0.23	6.6-7.8	0-2	Low-------	0.43			
	58-60	---	---	0.2-0.6	---	---	---	----------	----			
Canyon----------	0-5	10-20	1.25-1.45	0.6-2.0	0.20-0.22	7.4-8.4	0-2	Low-------	0.32	2	4L	1-3
	5-14	12-25	1.45-1.70	0.6-2.0	0.13-0.18	7.4-8.4	0-2	Low-------	0.20			
	14-60	---	---	0.2-0.6	---	---	---	----------	----			
On-------------- Onita	0-8	27-35	1.15-1.25	0.2-0.6	0.19-0.22	5.6-7.3	<2	Moderate	0.28	5	7	4-6
	8-32	40-50	1.20-1.40	0.06-0.2	0.11-0.17	6.1-7.3	<2	High------	0.43			
	32-60	25-35	1.25-1.40	0.2-2.0	0.17-0.20	7.4-8.4	<2	Moderate	0.43			
OrF------------- Orella	0-5	27-40	1.00-1.20	0.2-0.6	0.12-0.14	7.4-8.4	0-4	High------	0.37	2	4L	.5-1
	5-16	38-65	1.00-1.20	0.00-0.06	0.09-0.11	7.4-9.0	4-16	High------	0.32			
	16-60	---	---	0.06-0.2	---	---	---	----------	----			
OvD------------- Orpha	0-6	5-9	1.35-1.45	6.0-20	0.07-0.09	6.6-7.8	0-0	Low-------	0.17	5	2	.5-1
	6-12	2-8	1.35-1.50	6.0-20	0.06-0.09	6.6-7.8	0-0	Low-------	0.15			
	12-60	2-6	1.45-1.55	6.0-20	0.05-0.07	6.6-8.4	0-0	Low-------	0.15			

See footnote at end of table.

TABLE 19.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
OwF*:												
Orpha-----------	0-6	5-9	1.35-1.45	6.0-20	0.07-0.09	6.6-7.8	0-0	Low-------	0.17	5	2	.5-1
	6-11	2-8	1.35-1.50	6.0-20	0.06-0.09	6.6-7.8	0-0	Low-------	0.15			
	11-60	2-6	1.45-1.55	6.0-20	0.05-0.07	6.6-8.4	0-0	Low-------	0.15			
Niobrara--------	0-4	2-5	1.70-1.90	6.0-20	0.10-0.12	7.4-8.4	0-0	Low-------	0.17	2	2	.5-2
	4-13	2-5	1.70-1.90	6.0-20	0.06-0.11	7.4-8.4	0-0	Low-------	0.15			
	13-60	---	---	0.2-0.6	---	---	---	----------	----			
OxG*:												
Orpha-----------	0-6	5-9	1.35-1.45	6.0-20	0.07-0.09	6.6-7.8	0-0	Low-------	0.17	5	2	.5-1
	6-32	2-8	1.35-1.50	6.0-20	0.06-0.09	6.6-7.8	0-0	Low-------	0.15			
	32-60	2-6	1.45-1.55	6.0-20	0.05-0.07	6.6-8.4	0-0	Low-------	0.15			
Rock outcrop----	0-60	---	---	---	---	---	<2	----------	----	---	8	---
PoC, PoD--------- Ponderosa	0-18	10-18	1.20-1.40	2.0-6.0	0.17-0.19	6.6-7.3	0-0	Low-------	0.32	5	3	1-3
	18-30	5-18	1.55-1.80	2.0-6.0	0.12-0.18	6.6-7.8	0-0	Low-------	0.43			
	30-60	5-18	1.55-1.80	2.0-6.0	0.11-0.18	7.4-8.4	0-0	Low-------	0.43			
PtF*:												
Ponderosa-------	0-12	10-18	1.20-1.40	2.0-6.0	0.17-0.19	6.6-7.3	0-0	Low-------	0.32	5	3	1-3
	12-27	5-18	1.55-1.80	2.0-6.0	0.12-0.18	6.6-7.8	0-0	Low-------	0.43			
	27-60	5-18	1.55-1.80	2.0-6.0	0.11-0.18	7.4-8.4	0-0	Low-------	0.43			
Tassel----------	0-3	5-12	1.20-1.45	2.0-6.0	0.12-0.18	7.4-8.4	0-0	Low-------	0.37	2	3	1-3
	3-15	5-12	1.40-1.70	2.0-6.0	0.12-0.18	7.4-8.4	0-0	Low-------	0.28			
	15-60	---	---	0.2-0.6	---	---	---	----------	----			
Vetal-----------	0-7	10-18	1.20-1.30	2.0-6.0	0.17-0.21	5.6-7.8	0-0	Low-------	0.32	5	3	1-3
	7-42	12-18	1.25-1.40	2.0-6.0	0.11-0.17	6.1-7.8	0-0	Low-------	0.20			
	42-60	10-18	1.30-1.40	2.0-6.0	0.11-0.17	6.1-8.4	0-0	Low-------	0.20			
RoB-------------- Rosebud	0-9	8-20	1.20-1.45	0.6-2.0	0.22-0.24	6.6-7.8	0-2	Low-------	0.28	4	5	2-4
	9-17	23-35	1.15-1.30	0.6-2.0	0.15-0.17	6.6-8.4	0-2	Moderate	0.37			
	17-32	15-26	1.30-1.50	0.6-2.0	0.11-0.17	7.4-9.0	0-2	Low-------	0.28			
	32-60	---	---	0.2-0.6	---	---	---	----------	----			
SnB, SnC, SnD---- Satanta	0-14	5-15	1.30-1.40	0.6-2.0	0.16-0.18	6.1-7.8	<2	Low-------	0.20	5	3	1-2
	14-35	18-35	1.35-1.45	0.6-2.0	0.16-0.19	6.6-8.4	<2	Moderate	0.28			
	35-60	5-15	1.30-1.40	0.6-2.0	0.12-0.18	7.4-8.4	<2	Low-------	0.32			
SsD*:												
Satanta---------	0-10	5-15	1.30-1.40	0.6-2.0	0.16-0.18	6.1-7.8	<2	Low-------	0.20	5	3	1-2
	10-33	18-35	1.35-1.45	0.6-2.0	0.16-0.19	6.6-8.4	<2	Moderate	0.28			
	33-60	5-15	1.30-1.40	0.6-2.0	0.12-0.18	7.4-8.4	<2	Low-------	0.32			
Canyon----------	0-6	10-20	1.25-1.45	0.6-2.0	0.20-0.22	7.4-8.4	0-2	Low-------	0.32	2	4L	1-3
	6-14	12-25	1.45-1.70	0.6-2.0	0.13-0.18	7.4-8.4	0-2	Low-------	0.20			
	14-60	---	---	0.2-0.6	---	---	---	----------	----			
SsE*:												
Satanta---------	0-9	5-15	1.30-1.40	0.6-2.0	0.16-0.18	6.1-7.8	<2	Low-------	0.20	5	3	1-2
	9-32	18-35	1.35-1.45	0.6-2.0	0.16-0.19	6.6-8.4	<2	Moderate	0.28			
	32-50	5-15	1.30-1.40	0.6-2.0	0.12-0.18	7.4-8.4	<2	Low-------	0.32			
	50-60	2-15	1.45-1.55	6.0-20	0.08-0.10	7.4-8.4	<2	Low-------	0.17			
Canyon----------	0-6	10-20	1.25-1.45	0.6-2.0	0.20-0.22	7.4-8.4	0-2	Low-------	0.32	2	4L	1-3
	6-14	12-25	1.45-1.70	0.6-2.0	0.13-0.18	7.4-8.4	0-2	Low-------	0.20			
	14-60	---	---	0.2-0.6	---	---	---	----------	----			

See footnote at end of table.

TABLE 19.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
TfG*:												
Tassel----------	0-9	5-12	1.20-1.45	2.0-6.0	0.12-0.18	7.4-8.4	0-0	Low-------	0.37	2	3	1-3
	9-16	5-12	1.40-1.70	2.0-6.0	0.12-0.18	7.4-8.4	0-0	Low-------	0.28			
	16-60	---	---	0.2-0.6	---	---	---	----------	----			
Rock outcrop----	0-60	---	---	---	---	---	<2	----------	----	---	8	---
TgG*:												
Tassel----------	0-4	5-12	1.20-1.45	2.0-6.0	0.12-0.18	7.4-8.4	0-0	Low-------	0.37	2	3	1-3
	4-14	5-12	1.40-1.70	2.0-6.0	0.12-0.18	7.4-8.4	0-0	Low-------	0.28			
	14-60	---	---	0.2-0.6	---	---	---	----------	----			
Ponderosa-------	0-9	10-18	1.20-1.40	2.0-6.0	0.17-0.19	6.6-7.3	0-0	Low-------	0.32	5	3	1-3
	9-23	5-18	1.55-1.80	2.0-6.0	0.12-0.18	6.6-7.8	0-0	Low-------	0.43			
	23-60	5-18	1.55-1.80	2.0-6.0	0.11-0.18	7.4-8.4	0-0	Low-------	0.43			
Rock outcrop----	0-60	---	---	---	---	---	<2	----------	----	---	8	---
ThB, ThC, ThD---- Thirtynine	0-8	10-24	1.25-1.45	0.6-2.0	0.20-0.22	6.1-7.8	0-2	Low-------	0.28	5	5	2-4
	8-21	15-30	1.15-1.25	0.6-2.0	0.19-0.22	7.9-9.0	0-2	Moderate	0.49			
	21-60	6-18	1.15-1.25	0.6-2.0	0.16-0.20	7.9-9.0	0-2	Low-------	0.55			
To--------------- Tryon	0-6	5-15	1.30-1.50	2.0-6.0	0.16-0.18	5.6-8.4	0-0	Low-------	0.20	5	8	4-8
	6-60	1-7	1.50-1.70	6.0-20	0.06-0.08	5.6-7.8	0-0	Low-------	0.17			
Tp--------------- Tryon	0-5	5-15	1.30-1.50	2.0-6.0	0.16-0.18	5.6-8.4	0-0	Low-------	0.20	5	8	4-8
	5-60	1-7	1.50-1.70	6.0-20	0.06-0.08	5.6-7.8	0-0	Low-------	0.17			
TtB, TtD--------- Tuthill	0-11	3-10	1.35-1.55	6.0-20	0.10-0.12	6.6-7.8	0-0	Low-------	0.17	5	2	1-3
	11-30	10-27	1.30-1.65	0.6-2.0	0.15-0.19	6.6-7.8	0-0	Moderate	0.37			
	30-60	3-10	1.55-1.80	6.0-20	0.05-0.10	7.4-8.4	0-0	Low-------	0.15			
TwB, TwC, TwD---- Tuthill	0-9	10-20	1.25-1.40	0.6-6.0	0.14-0.17	6.1-7.8	0-2	Low-------	0.20	4	3	1-3
	9-21	18-35	1.25-1.40	0.6-2.0	0.09-0.18	6.1-7.8	0-2	Moderate	0.32			
	21-60	3-10	1.40-1.60	6.0-20	0.06-0.10	7.4-8.4	0-2	Low-------	0.17			
VaB, VaD, VaE---- Valent	0-4	2-6	1.55-1.65	6.0-20	0.05-0.10	6.6-7.8	<2	Low-------	0.15	5	1	.5-1
	4-60	2-8	1.60-1.70	6.0-20	0.05-0.10	6.6-7.8	<2	Low-------	0.15			
VaF*:												
Valent, rolling-	0-4	2-6	1.55-1.65	6.0-20	0.05-0.10	6.6-7.8	<2	Low-------	0.15	5	1	.5-1
	4-60	2-8	1.60-1.70	6.0-20	0.05-0.10	6.6-7.8	<2	Low-------	0.15			
Valent, hilly---	0-4	2-6	1.55-1.65	6.0-20	0.05-0.10	6.6-7.8	<2	Low-------	0.15	5	1	.5-1
	4-60	2-8	1.60-1.70	6.0-20	0.05-0.10	6.6-7.8	<2	Low-------	0.15			
VaG-------------- Valent	0-4	2-6	1.55-1.65	6.0-20	0.05-0.10	6.6-7.8	<2	Low-------	0.15	5	1	.5-1
	4-60	2-8	1.60-1.70	6.0-20	0.05-0.10	6.6-7.8	<2	Low-------	0.15			
VeB, VeD--------- Valent	0-5	3-10	1.55-1.65	6.0-20	0.07-0.12	6.6-7.8	<2	Low-------	0.17	5	2	.5-1
	5-60	2-8	1.60-1.70	6.0-20	0.05-0.10	6.6-7.8	<2	Low-------	0.15			
VnD, VnE--------- Valentine	0-6	0-6	1.40-1.60	6.0-20	0.07-0.09	5.6-7.3	0-0	Low-------	0.15	5	1	.5-1
	6-60	0-8	1.55-1.80	6.0-20	0.05-0.11	5.6-7.3	0-0	Low-------	0.15			
VnF*:												
Valentine, rolling--------	0-6	0-6	1.40-1.60	6.0-20	0.07-0.09	5.6-7.3	0-0	Low-------	0.15	5	1	.5-1
	6-60	0-8	1.55-1.80	6.0-20	0.05-0.11	5.6-7.3	0-0	Low-------	0.15			
Valentine, hilly	0-6	0-6	1.40-1.60	6.0-20	0.07-0.09	5.6-7.3	0-0	Low-------	0.15	5	1	.5-1
	6-60	0-8	1.55-1.80	6.0-20	0.05-0.11	5.6-7.3	0-0	Low-------	0.15			

See footnote at end of table.

TABLE 19.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
VnG--------------	0-6	0-6	1.40-1.60	6.0-20	0.07-0.09	5.6-7.3	0-0	Low-------	0.15	5	1	.5-1
Valentine	6-60	0-8	1.55-1.80	6.0-20	0.05-0.11	5.6-7.3	0-0	Low-------	0.15			
VsB--------------	0-7	5-10	1.25-1.35	2.0-6.0	0.10-0.12	6.6-7.8	0-2	Low-------	0.17	5	2	1-3
Vetal	7-40	12-18	1.25-1.35	2.0-6.0	0.11-0.19	6.6-7.8	0-2	Low-------	0.20			
	40-60	5-10	1.40-1.50	6.0-20	0.08-0.10	7.4-8.4	0-2	Low-------	0.15			
Vt---------------	0-7	10-18	1.25-1.40	2.0-6.0	0.11-0.17	5.6-7.8	0-0	Low-------	0.20	5	3	1-3
Vetal	7-43	12-18	1.25-1.40	2.0-6.0	0.11-0.17	6.1-7.8	0-0	Low-------	0.20			
	43-60	5-10	1.40-1.50	6.0-20	0.08-0.10	6.1-8.4	0-0	Low-------	0.20			
WrB--------------	0-5	2-10	1.60-1.90	6.0-20	0.03-0.10	8.5-9.9	0-8	Low-------	0.15	5	1	.5-3
Wildhorse	5-60	1-10	1.50-1.70	6.0-20	0.01-0.08	8.5-9.6	0-4	Low-------	0.15			
WsB*:												
Wildhorse-------	0-6	2-10	1.60-1.90	6.0-20	0.03-0.10	8.5-9.9	0-8	Low-------	0.15	5	1	.5-3
	6-60	1-10	1.50-1.70	6.0-20	0.01-0.08	8.5-9.6	0-4	Low-------	0.15			
Hoffland--------	0-11	15-20	1.20-1.50	2.0-6.0	0.16-0.19	7.9-8.4	0-2	Low-------	0.20	5	8	4-12
	11-60	1-10	1.40-1.70	6.0-20	0.06-0.11	6.6-8.4	0-0	Low-------	0.15			
WtB*:												
Wildhorse-------	0-6	2-10	1.60-1.90	6.0-20	0.03-0.10	8.5-9.9	0-8	Low-------	0.15	5	1	.5-3
	6-60	1-10	1.50-1.70	6.0-20	0.01-0.08	8.5-9.6	0-4	Low-------	0.15			
Ipage-----------	0-6	1-5	1.40-1.50	6.0-20	0.07-0.09	6.6-8.4	0-2	Low-------	0.15	5	1	.5-1
	6-60	1-8	1.50-1.60	6.0-20	0.04-0.10	6.6-8.4	0-2	Low-------	0.15			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 20.--SOIL AND WATER FEATURES

("Flooding," "water table," and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
Ac, AcB, AcC------ Alliance	B	None--------	---	---	>6.0	---	---	40-60	Soft	Moderate	Moderate	Low.
An---------------- Almeria	D	Frequent----	Brief-----	Feb-Jul	+.5-1.0	Apparent	Nov-Jun	>80	---	Moderate	High-----	Low.
Bc---------------- Bankard	A	Frequent----	Very brief	Mar-Aug	>6.0	---	---	>60	---	Low------	Low------	Low.
Bd---------------- Beckton	D	Rare--------	---	---	4.0-6.0	Apparent	Apr-May	>60	---	Low------	High-----	High.
Bf---------------- Bolent	A	Occasional	Brief-----	Mar-Jun	1.5-3.0	Apparent	Nov-May	>60	---	Moderate	Low------	Low.
Bh, BhB, Bm------- Bridget	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
BnB, BnE---------- Bufton	C	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	Low.
BoD*:												
Bufton-----------	C	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	Low.
Orella-----------	D	None--------	---	---	>6.0	---	---	10-20	Soft	Low------	High-----	Low.
BsB, BsC, BsD----- Busher	B	None--------	---	---	>6.0	---	---	40-60	Soft	Low------	Low------	Low.
BvC*, BvF*:												
Busher-----------	B	None--------	---	---	>6.0	---	---	40-60	Soft	Low------	Low------	Low.
Tassel-----------	D	None--------	---	---	>6.0	---	---	6-20	Soft	Low------	Low------	Low.
Ca---------------- Calamus	A	Rare--------	---	---	3.0-6.0	Apparent	Mar-Jun	>80	---	Low------	Low------	Low.
Cr---------------- Crowther	D	Rare--------	---	---	0-1.5	Apparent	Nov-May	>60	---	Moderate	High-----	Low.
Cs---------------- Crowther	D	Rare--------	---	---	+.5-1.0	Apparent	Nov-May	>60	---	Moderate	High-----	Low.

See footnote at end of table.

TABLE 20.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
DuB, DuD: Dailey	A	None	---	---	>6.0	---	---	>60	---	Low	High	Low.
Dw: Duroc	B	Rare	Very brief	---	>6.0	---	---	>60	---	Low	Low	Low.
DwB: Duroc	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
Ec: Els	A	Rare	---	---	1.5-3.0	Apparent	Nov-May	>80	---	Moderate	Moderate	Moderate.
Ef*:												
Els	A	Rare	---	---	1.5-3.0	Apparent	Nov-May	>80	---	Moderate	Moderate	Moderate.
Hoffland	D	Rare	---	---	0-1.5	Apparent	Nov-May	>80	---	Moderate	High	Low.
EgB*:												
Els	A	Rare	---	---	1.5-3.0	Apparent	Nov-May	>80	---	Moderate	Moderate	Moderate.
Ipage	A	None	---	---	3.0-5.0	Apparent	Dec-Jun	>80	---	Moderate	Low	Moderate.
En*:												
Els	A	Rare	---	---	1.5-3.0	Apparent	Nov-May	>80	---	Moderate	Moderate	Moderate.
Tryon	D	Rare	---	---	0-1.5	Apparent	Nov-May	>80	---	Moderate	High	Low.
Es: Elsmere	A	Rare	---	---	1.5-3.0	Apparent	Nov-May	>80	---	Moderate	Moderate	Low.
EuE*:												
Enning	D	None	---	---	>6.0	---	---	10-20	Soft	Low	Moderate	Moderate.
Minnequa	C	None	---	---	>6.0	---	---	20-40	Soft	Low	High	Low.
EvG*:												
Enning	D	None	---	---	>6.0	---	---	10-20	Soft	Low	Moderate	Moderate.
Rock outcrop	D	None	---	---	>6.0	---	---	0	Soft	---	---	---
EwG*:												
Epping	D	None	---	---	>6.0	---	---	10-20	Soft	Low	Low	Low.
Badland	D	None	---	---	>6.0	---	---	0-3	Soft	---	---	---

See footnote at end of table.

TABLE 20.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Fu---------------- Fluvaquents	D	Frequent----	Brief to very long.	Nov-Jun	+2-1.0	Apparent	Jan-Dec	>60	---	Moderate	High-----	Low.
Gg---------------- Gannett	D	Rare--------	---	---	0-1.5	Apparent	Nov-May	>60	---	High-----	High-----	Low.
Gh---------------- Gannett	D	Rare--------	---	---	+.5-1.0	Apparent	Nov-May	>80	---	High-----	High-----	Low.
Hm---------------- Hoffland	D	Rare--------	---	---	0-1.5	Apparent	Nov-May	>80	---	Moderate	High-----	Low.
Hn---------------- Hoffland	D	Rare--------	---	---	+.5-1.0	Apparent	Nov-May	>80	---	Moderate	High-----	Low.
IpB--------------- Ipage	A	None--------	---	---	3.0-5.0	Apparent	Dec-Jun	>80	---	Moderate	Low------	Moderate.
JgB, JgC, JgD----- Jayem	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
Jo---------------- Johnstown	B	None--------	---	---	>6.0	---	---	>80	---	Moderate	Moderate	Low.
Kd, KdC, KdD------ Kadoka	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate	Low.
Ke, KeB, KeC, Kg, KgB, KgC--------- Keith	B	None--------	---	---	>6.0	---	---	>80	---	Moderate	Moderate	Low.
Ky---------------- Keya	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
La---------------- Las Animas	C	Occasional	Brief-----	Mar-Aug	1.5-3.0	Apparent	Nov-May	>60	---	Moderate	High-----	Low.
Lg---------------- Lodgepole	D	None--------	---	---	+.5-1.0	Perched	Mar-Jul	>80	---	High-----	High-----	Low.
Lu---------------- Lute	D	Rare--------	---	---	1.0-3.0	Perched	Apr-Jul	>60	---	High-----	High-----	Moderate.
MbC--------------- Manvel	B	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	Low.

See footnote at end of table.

TABLE 20.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
Mc: Marlake	D	None	---	---	+2-1.0	Apparent	Oct-Jun	>60	---	Moderate	High	Low.
Mk: McCook	B	Rare	---	---	>6.0	---	---	>80	---	Moderate	High	Low.
Mm: McCook	B	Frequent	Very brief	Apr-Jul	>6.0	---	---	>80	---	Moderate	Low	Low.
MxF*:												
Mitchell	B	None	---	---	>6.0	---	---	>80	---	Low	Low	Low.
Epping	D	None	---	---	>6.0	---	---	10-20	Soft	Low	Low	Low.
My: Munjor	B	Rare	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
Mz: Munjor	B	Frequent	Very brief	Apr-Sep	>6.0	---	---	>60	---	Low	Moderate	Low.
OhC*, OhD*, OhF*:												
Ogiala	B	None	---	---	>6.0	---	---	40-60	Soft	Moderate	Moderate	Low.
Canyon	D	None	---	---	>6.0	---	---	6-20	Soft	Low	Low	Low.
On: Onita	C	Rare	---	---	3.0-6.0	Perched	Mar-Jun	>60	---	High	High	Low.
OrF: Orella	D	None	---	---	>6.0	---	---	10-20	Soft	Low	High	Low.
OvD: Orpha	A	None	---	---	>6.0	---	---	>80	---	Low	Moderate	Low.
OwF*:												
Orpha	A	None	---	---	>6.0	---	---	>80	---	Low	Moderate	Low.
Niobrara	D	None	---	---	>6.0	---	---	10-20	Soft	Low	Low	Low.
OxG*:												
Orpha	A	None	---	---	>6.0	---	---	>80	---	Low	Moderate	Low.
Rock outcrop	D	None	---	---	>6.0	---	---	0	Soft	---	---	---
PoC, PoD: Ponderosa	B	None	---	---	>6.0	---	---	>80	---	Low	Low	Low.

See footnote at end of table.

TABLE 20.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
PtF*:												
Ponderosa--------	B	None--------	---	---	>6.0	---	---	>80	---	Low------	Low------	Low.
Tassel-----------	D	None--------	---	---	>6.0	---	---	6-20	Soft	Low------	Low------	Low.
Vetal------------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
RoB--------------- Rosebud	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Low.
SnB, SnC, SnD----- Satanta	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
SsD*, SsE*:												
Satanta----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
Canyon-----------	D	None--------	---	---	>6.0	---	---	6-20	Soft	Low------	Low------	Low.
TfG*:												
Tassel-----------	D	None--------	---	---	>6.0	---	---	6-20	Soft	Low------	Low------	Low.
Rock outcrop-----	D	None--------	---	---	>6.0	---	---	0	Soft	---	---	---
TgG*:												
Tassel-----------	D	None--------	---	---	>6.0	---	---	6-20	Soft	Low------	Low------	Low.
Ponderosa--------	B	None--------	---	---	>6.0	---	---	>80	---	Low------	Low------	Low.
Rock outcrop-----	D	None--------	---	---	>6.0	---	---	0	Soft	---	---	---
ThB, ThC, ThD----- Thirtynine	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
To---------------- Tryon	D	Rare--------	---	---	0-1.5	Apparent	Nov-May	>80	---	Moderate	High-----	Low.
Tp---------------- Tryon	D	Rare--------	---	---	+.5-1.0	Apparent	Nov-May	>80	---	Moderate	High-----	Low.
TtB, TtD---------- Tuthill	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Low.
TwB, TwC, TwD----- Tuthill	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
VaB, VaD, VaE----- Valent	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.

See footnote at end of table.

TABLE 20.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
VaF*:												
Valent, rolling--	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
Valent, hilly----	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
VaG, VeB, VeD----- Valent	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
VnD, VnE---------- Valentine	A	None--------	---	---	>6.0	---	---	>80	---	Low------	Low------	Low.
VnF*:												
Valentine, rolling---------	A	None--------	---	---	>6.0	---	---	>80	---	Low------	Low------	Low.
Valentine, hilly-	A	None--------	---	---	>6.0	---	---	>80	---	Low------	Low------	Low.
VnG--------------- Valentine	A	None--------	---	---	>6.0	---	---	>80	---	Low------	Low------	Low.
VsB--------------- Vetal	B	None--------	---	---	>6.0	---	---	>80	---	Moderate	Moderate	Low.
Vt---------------- Vetal	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
WrB--------------- Wildhorse	A	None--------	---	---	1.5-3.5	Apparent	Nov-May	>80	---	Moderate	High-----	High.
WsB*:												
Wildhorse--------	A	None--------	---	---	1.5-3.5	Apparent	Nov-May	>80	---	Moderate	High-----	High.
Hoffland---------	D	Rare--------	---	---	0-1.5	Apparent	Nov-May	>80	---	Moderate	High-----	Low.
WtB*:												
Wildhorse--------	A	None--------	---	---	1.5-3.5	Apparent	Nov-May	>80	---	Moderate	High-----	High.
Ipage------------	A	None--------	---	---	3.0-5.0	Apparent	Dec-Jun	>80	---	Moderate	Low------	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 21.--ENGINEERING INDEX TEST DATA

(Dashes indicate that data were not available. LL means liquid limit; PI, plasticity index; and NP, nonplastic)

Soil name, report number, horizon, and depth in inches*	Classification		Grain-size distribution										
			Percentage passing sieve--						Percentage smaller than--		LL	PI	Specific gravity
	AASHTO	Unified	3/4 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.002 mm			
											Pct		
Beckton silt loam (S89NE-161-26)													
A------ 0 to 5	A-5(8)	ML	---	---	---	---	100	88	78	15	41	7	2.46
Btn---- 8 to 18	A-7-6 (16)	CL	---	---	---	---	---	96	91	34	50	26	2.56
C1----- 35 to 50	A-7-6 (16)	CL	---	---	---	---	99	96	91	26	46	21	2.60
Ipage fine sand (S90NE-161-12)													
A------ 0 to 4	A-2-4 (2)	SP-SM	---	---	---	100	98	5	5	1	NP	NP	2.64
AC----- 4 to 9	A-2-4 (2)	SP	---	---	---	100	98	4	4	1	NP	NP	2.62
C------ 9 to 60	A-2-4 (2)	SP	---	---	---	100	98	3	3	0	NP	NP	2.62
Keith loam (S85NE-161-41)													
Ap----- 0 to 6	A-4(8)	CL-ML	---	---	---	---	99	81	68	16	25	5	2.60
Bt----- 11 to 19	A-6(12)	CL	---	---	---	---	99	85	76	32	39	20	2.64
BCk---- 28 to 38	A-4(8)	CL	---	---	---	---	---	93	80	17	30	7	2.67
C------ 38 to 60	A-4(8)	ML	---	---	---	---	99	82	60	11	25	3	2.66
Oglala loam (S90NE-161-24)													
A------ 0 to 8	A-4(8)	ML	---	---	---	100	99	88	59	16	33	9	2.56
C1----- 11 to 33	A-4(7)	ML	---	---	---	100	97	68	55	10	30	3	2.61
Ponderosa very fine sandy loam (S90NE-161-25)													
A------ 0 to 12	A-4(5)	ML	---	---	---	---	100	59	30	12	24	NP	2.62
C1----- 21 to 29	A-4(2)	ML	---	---	---	---	100	44	24	9	20	NP	2.61
Satanta fine sandy loam (S85NE-161-40)													
Ap----- 0 to 6	A-4(2)	ML	---	---	---	---	98	43	30	11	19	NP	2.62
Bt1---- 9 to 18	A-6(10)	CL	---	---	---	---	100	70	57	29	35	17	2.63
C------ 39 to 60	A-4(6)	ML	---	---	---	---	99	66	40	10	23	NP	2.63

See footnote at end of table.

TABLE 21.--ENGINEERING INDEX TEST DATA--Continued

Soil name, report number, horizon, and depth in inches*	Classification		Grain-size distribution								LL	PI	Specific gravity
			Percentage passing sieve--						Percentage smaller than--				
	AASHTO	Unified	3/4 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.002 mm			
											Pct		
Tassel very fine sandy loam (S90NE-161-2)													
A------ 0 to 3	A-4(8)	ML	100	98	98	97	96	75	46	7	31	1	2.56
C------ 6 to 17	A-4(8)	ML	99	98	98	98	97	74	41	9	29	NP	2.58
Valent fine sand (S90NE-161-18)													
A------ 0 to 2	A-3(2)	SP-SM	---	---	---	---	100	6	5	1	NP	NP	2.60
C------ 2 to 60	A-4(2)	SP	---	---	---	---	100	3	3	1	NP	NP	2.63
Wildhorse fine sand (S90NE-161-10)													
A------ 0 to 2	A-4(0)	SM	---	---	---	100	99	37	30	6	NP	NP	2.50
C1----- 2 to 24	A-4(0)	SC-SM	---	---	---	100	99	31	24	10	23	6	2.60
C2----- 24 to 60	A-2-4 (0)	SM	---	---	---	100	99	27	22	10	20	3	2.62

* The locations of the sampled pedons are as follows:

Beckton silt loam, 450 feet west and 600 feet south of the northwest corner of sec. 31, T. 3 N., R. 45 W.

Ipage fine sand, 1,100 feet east and 1,400 feet north of the southwest corner of sec. 24, T. 35 N., R. 42 W.

Keith loam, 250 feet south and 250 feet west of the northeast corner of sec. 21, T. 35 N., R. 42 W.

Oglala loam, 2,200 feet west and 1,500 feet north of the southeast corner of sec. 35, T. 33 N., R. 45 W.

Ponderosa very fine sandy loam, 1,400 feet north and 600 feet east of the southwest corner of sec. 7, T. 34 N., R. 45 W.

Satanta fine sandy loam, 950 feet west and 550 feet south of the northeast corner of sec. 19, T. 26 N., R. 46 W.

Tassel very fine sandy loam, 1,400 feet east and 1,800 feet north of the southwest corner of sec. 36, T. 35 N., R. 43 W.

Valent fine sand, 250 feet north and 1,050 feet east of the southwest corner of sec. 5, T. 26 N., R. 44 W.

Wildhorse fine sand, 500 feet east and 500 feet north of the southwest corner of sec. 14, T. 26 N., R. 45 W.

TABLE 22.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Alliance	Fine-silty, mixed, mesic Aridic Argiustolls
Almeria	Sandy, mixed, mesic Typic Fluvaquents
Bankard	Sandy, mixed, mesic Ustic Torrifluvents
Beckton	Fine, montmorillonitic, mesic Aridic Natrustolls
Bolent	Sandy, mixed, mesic Aquic Ustifluvents
Bridget	Coarse-silty, mixed, mesic Torriorthentic Haplustolls
Bufton	Fine, mixed, mesic Aridic Ustochrepts
Busher	Coarse-loamy, mixed, mesic Aridic Haplustolls
Calamus	Mixed, mesic Aquic Ustipsamments
Canyon	Loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents
Crowther	Coarse-loamy over sandy or sandy-skeletal, mesic Typic Calciaquolls
Dailey	Sandy, mixed, mesic Torriorthentic Haplustolls
Duroc	Fine-silty, mixed, mesic Pachic Haplustolls
Els	Mixed, mesic Aquic Ustipsamments
Elsmere	Sandy, mixed, mesic Aquic Haplustolls
Enning	Loamy, carbonatic, mesic, shallow Ustic Torriorthents
Epping	Loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents
Fluvaquents	Fluvaquents
Gannett	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic Typic Haplaquolls
Hoffland	Sandy, mixed, mesic Mollic Endoaquepts
Ipage	Mixed, mesic Oxyaquic Ustipsamments
Jayem	Coarse-loamy, mixed, mesic Aridic Haplustolls
Johnstown	Fine-silty, mixed, mesic Pachic Argiustolls
Kadoka	Fine-silty, mixed, mesic Aridic Argiustolls
Keith	Fine-silty, mixed, mesic Aridic Argiustolls
Keya	Fine-loamy, mixed, mesic Pachic Argiustolls
Las Animas	Coarse-loamy, mixed (calcareous), mesic Typic Fluvaquents
Lodgepole	Fine, montmorillonitic, mesic Typic Argiaquolls
Lute	Fine-loamy, mixed, mesic Typic Natraquolls
Manvel	Fine-silty, mixed (calcareous), mesic Ustic Torriorthents
Marlake	Mixed, mesic Mollic Psammaquents
McCook	Coarse-silty, mixed, mesic Fluventic Haplustolls
Minnequa	Fine-silty, mixed (calcareous), mesic Ustic Torriorthents
Mitchell	Coarse-silty, mixed (calcareous), mesic Ustic Torriorthents
Munjor	Coarse-loamy, mixed (calcareous), mesic Typic Ustifluvents
Niobrara	Mixed, mesic, shallow Ustic Torripsamments
Oglala	Coarse-silty, mixed, mesic Aridic Haplustolls
Onita	Fine, montmorillonitic, mesic Pachic Argiustolls
Orella	Clayey, mixed (calcareous), mesic, shallow Ustic Torriorthents
Orpha	Mixed, mesic Ustic Torripsamments
Ponderosa	Coarse-loamy, mixed, mesic Torriorthentic Haplustolls
Rosebud	Fine-loamy, mixed, mesic Aridic Argiustolls
Satanta	Fine-loamy, mixed, mesic Aridic Argiustolls
Tassel	Loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents
Thirtynine	Fine-silty, mixed, mesic Aridic Argiustolls
Tryon	Mixed, mesic Typic Psammaquents
Tuthill	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aridic Argiustolls
Valent	Mixed, mesic Ustic Torripsamments
Valentine	Mixed, mesic Typic Ustipsamments
Vetal	Coarse-loamy, mixed, mesic Pachic Haplustolls
Wildhorse	Sandy, mixed, mesic Typic Halaquepts

Interpretive Groups

INTERPRETIVE GROUPS

(Dashes indicate that the soil was not assigned to the interpretive group. N means nonirrigated and I, irrigated)

Map symbol and soil name	Land capability N	Land capability I	Prime farmland	Range site	Windbreak suitability group
Ac-----Alliance	IIc-1	I-4	Yes*	Silty	3
AcB-----Alliance	IIe-1	IIe-4	Yes*	Silty	3
AcC-----Alliance	IIIe-1	IIIe-4	Yes*	Silty	3
An-----Almeria	VIw-7	---	---	Wetland	10
Bc-----Bankard	VIw-5	---	---	Sandy Lowland	10
Bd-----Beckton	IVs-1	IVs-5	---	Saline Lowland	9S
Bf-----Bolent	IVw-5	IVw-11	---	Subirrigated	2S
Bh-----Bridget	IIc-1	IIe-6	Yes*	Silty	3
BhB-----Bridget	IIe-3	IIe-6	Yes*	Silty	3
Bm-----Bridget	IIc-1	I-6	Yes*	Silty	3
BnB-----Bufton	IIIe-1	IIIe-3	---	Clayey	4L
BnE-----Bufton	VIe-1	---	---	Clayey	4L
BoD:					
Bufton	IVe-1	IVe-3	---	Clayey	4L
Orella	VIs-4	---	---	Saline Upland	10
BsB-----Busher	IIIe-3	IIe-8	Yes*	Sandy	5
BsC-----Busher	IIIe-3	IIIe-8	Yes*	Sandy	5
BsD-----Busher	IVe-3	IVe-8	---	Sandy	5
BvC:					
Busher	IIIe-3	IIIe-8	---	Sandy	5
Tassel	VIs-4	---	---	Shallow Limy	10
BvF:					
Busher	VIe-3	---	---	Sandy	10
Tassel	VIs-4	---	---	Shallow Limy	10

See footnotes at end of table.

INTERPRETIVE GROUPS--Continued

Map symbol and soil name	Land capability N	Land capability I	Prime farmland	Range site	Windbreak suitability group
Ca Calamus	VIe-5	IVe-11	---	Sandy	7
Cr Crowther	Vw-7	---	---	Wet Subirrigated	2D
Cs Crowther	Vw-7	---	---	Wetland	10
DuB Dailey	IVe-5	IVe-11	---	Sandy	5
DuD Dailey	VIe-5	IVe-11	---	Sandy	7
Dw Duroc	IIc-1	I-6	Yes*	Silty Lowland	1
DwB Duroc	IIe-1	IIe-6	Yes*	Silty	3
Ec Els	VIe-5	IVw-12	---	Subirrigated	2S
Ef:					
Els	VIe-5	IVw-12	---	Subirrigated	2S
Hoffland	Vw-7	---	---	Wet Subirrigated	2D
EgB:					
Els	VIe-5	IVw-12	---	Subirrigated	2S
Ipage	VIe-5	IVe-12	---	Sandy Lowland	7
En:					
Els	VIe-5	IVw-12	---	Subirrigated	2S
Tryon	Vw-7	---	---	Wet Subirrigated	2D
Es Elsmere	IVw-5	IVw-11	---	Subirrigated	2S
EuE:					
Enning	VIs-4	---	---	Shallow Limy	10
Minnequa	VIe-9	---	---	Limy Upland	3
EvG:					
Enning	VIIs-4	---	---	Shallow Limy	10
Rock outcrop	VIIIs-8	---	---	---	10
EwG:					
Epping	VIIs-4	---	---	Shallow Limy	10
Badland	VIIIs-8	---	---	---	10
Fu Fluvaquents	VIIIw-7	---	---	---	10
Gg Gannett	Vw-7	---	---	Wet Subirrigated	2D
Gh Gannett	Vw-7	---	---	Wetland	10

See footnotes at end of table.

INTERPRETIVE GROUPS--Continued

Map symbol and soil name	Land capability N	Land capability I	Prime farmland	Range site	Windbreak suitability group
Hm-------------------------- Hoffland	Vw-7	---	---	Wet Subirrigated-----	2D
Hn-------------------------- Hoffland	Vw-7	---	---	Wetland--------------	10
IpB------------------------- Ipage	VIe-5	IVe-12	---	Sandy Lowland--------	7
JgB------------------------- Jayem	IIIe-3	IIe-8	Yes*	Sandy----------------	5
JgC------------------------- Jayem	IVe-3	IIIe-8	Yes*	Sandy----------------	5
JgD------------------------- Jayem	IVe-3	IVe-8	---	Sandy----------------	5
Jo-------------------------- Johnstown	IIc-1	I-4	Yes*	Silty----------------	3
Kd-------------------------- Kadoka	IIc-1	I-4	Yes*	Silty----------------	6R
KdC------------------------- Kadoka	IIIe-1	IIIe-4	Yes*	Silty----------------	6R
KdD------------------------- Kadoka	IVe-1	IVe-4	---	Silty----------------	6R
Ke-------------------------- Keith	IIc-1	I-4	Yes*	Silty----------------	3
KeB------------------------- Keith	IIe-1	IIe-4	Yes*	Silty----------------	3
KeC------------------------- Keith	IIIe-1	IIIe-4	Yes*	Silty----------------	3
Kg-------------------------- Keith	IIc-1	I-4	Yes*	Silty----------------	3
KgB------------------------- Keith	IIe-1	IIe-4	Yes*	Silty----------------	3
KgC------------------------- Keith	IIIe-1	IIIe-4	Yes*	Silty----------------	3
Ky-------------------------- Keya	IIc-1	I-4	Yes*	Silty----------------	3
La-------------------------- Las Animas	IIw-4	IIw-8	Yes**	Subirrigated---------	2S
Lg-------------------------- Lodgepole	IIIw-2	IVw-2	---	Clayey Overflow------	2W
Lu-------------------------- Lute	VIs-1	---	---	Saline Subirrigated--	10

See footnotes at end of table.

INTERPRETIVE GROUPS--Continued

Map symbol and soil name	Land capability N	Land capability I	Prime farmland	Range site	Windbreak suitability group
MbC-- Manvel	IVe-1	IVe-3	---	Limy Upland	8
Mc-- Marlake	VIIIw-7	---	---	---	10
Mk-- McCook	IIc-1	I-6	Yes*	Silty Lowland	1L
Mm-- McCook	VIw-7	---	---	Silty Overflow	10
MxF:					
Mitchell	VIe-9	---	---	Limy Upland	10
Epping	VIs-4	---	---	Shallow Limy	10
My-- Munjor	IIIe-3	IIe-8	Yes*	Sandy Lowland	1L
Mz-- Munjor	VIw-7	---	---	Sandy Lowland	10
OhC:					
Oglala	IIIe-1	IIIe-6	---	Silty	3
Canyon	VIs-4	---	---	Shallow Limy	10
OhD:					
Oglala	IVe-1	IVe-6	---	Silty	3
Canyon	VIs-4	---	---	Shallow Limy	10
OhF:					
Oglala	VIe-1	---	---	Silty	10
Canyon	VIs-4	---	---	Shallow Limy	10
On-- Onita	IIs-2	IIs-3	---	Clayey	1
OrF-- Orella	VIs-4	---	---	Saline Upland	10
OvD-- Orpha	VIe-5	IVe-11	---	Sands	7
OwF:					
Orpha	VIe-5	---	---	Sands	10
Niobrara	VIs-4	---	---	Shallow Limy	10
OxG:					
Orpha	VIIe-5	---	---	Sands	10
Rock outcrop	VIIIs-8	---	---	---	10
PoC-- Ponderosa	IIIe-3	IIIe-8	Yes*	Sandy	5
PoD-- Ponderosa	IVe-3	IVe-8	---	Sandy	5

See footnotes at end of table.

INTERPRETIVE GROUPS--Continued

Map symbol and soil name	Land capability N	Land capability I	Prime farmland	Range site	Windbreak suitability group
PtF:					
Ponderosa	VIe-3	---	---	Sandy	10
Tassel	VIs-4	---	---	Shallow Limy	10
Vetal	VIe-3	---	---	Sandy	5
RoB	IIIe-1	IIIe-4	Yes*	Silty	6R
Rosebud					
SnB	IIIe-3	IIe-5	Yes*	Silty	5
Satanta					
SnC	IIIe-3	IIIe-5	Yes*	Silty	5
Satanta					
SnD	IVe-3	IVe-5	---	Silty	5
Satanta					
SsD:					
Satanta	IVe-3	IVe-5	---	Silty	5
Canyon	VIs-4	---	---	Shallow Limy	10
SsE:					
Satanta	VIe-1	---	---	Silty	5
Canyon	VIs-4	---	---	Shallow Limy	10
TfG:					
Tassel	VIIs-4	---	---	Shallow Limy	10
Rock outcrop	VIIIs-8	---	---	---	10
TgG:					
Tassel	VIIs-4	---	---	Shallow Limy	10
Ponderosa	VIe-3	---	---	Savannah	10
Rock outcrop	VIIIs-8	---	---	---	10
ThB	IIe-1	IIe-4	Yes*	Silty	3
Thirtynine					
ThC	IIIe-1	IIIe-4	Yes*	Silty	3
Thirtynine					
ThD	IVe-1	IVe-4	---	Silty	3
Thirtynine					
To	Vw-7	---	---	Wet Subirrigated	2D
Tryon					
Tp	Vw-7	---	---	Wetland	10
Tryon					
TtB	IVe-6	IIIe-10	---	Sandy	5
Tuthill					
TtD	VIe-6	IVe-10	---	Sandy	5
Tuthill					
TwB	IIIe-3	IIe-5	Yes*	Sandy	5
Tuthill					
TwC	IIIe-3	IIIe-5	Yes*	Sandy	5
Tuthill					

See footnotes at end of table.

INTERPRETIVE GROUPS--Continued

Map symbol and soil name	Land capability N	Land capability I	Prime farmland	Range site	Windbreak suitability group
TwD: Tuthill	IVe-3	IVe-5	---	Sandy	5
VaB: Valent	VIe-5	IVe-12	---	Sandy	7
VaD: Valent	VIe-5	IVe-12	---	Sands	7
VaE: Valent	VIe-5	---	---	Sands	7
VaF:					
Valent, rolling	VIe-5	---	---	Sands	7
Valent, hilly	VIIe-5	---	---	Choppy Sands	10
VaG: Valent	VIIe-5	---	---	Choppy Sands	10
VeB: Valent	VIe-5	IVe-11	---	Sandy	7
VeD: Valent	VIe-5	IVe-11	---	Sands	7
VnD: Valentine	VIe-5	IVe-12	---	Sands	7
VnE: Valentine	VIe-5	---	---	Sands	7
VnF:					
Valentine, rolling	VIe-5	---	---	Sands	7
Valentine, hilly	VIIe-5	---	---	Choppy Sands	10
VnG: Valentine	VIIe-5	---	---	Choppy Sands	10
VsB: Vetal	IIIe-5	IIIe-10	---	Sandy	5
Vt: Vetal	IIe-3	IIe-8	Yes*	Sandy	5
WrB: Wildhorse	VIs-1	---	---	Saline Subirrigated	10
WsB:					
Wildhorse	VIs-1	---	---	Saline Subirrigated	10
Hoffland	Vw-7	---	---	Wet Subirrigated	2D
WtB:					
Wildhorse	VIs-1	---	---	Saline Subirrigated	10
Ipage	VIe-5	IVe-12	---	Sandy Lowland	7

* Where irrigated.
** Where drained.

Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at (800) 457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

Nondiscrimination Statement

Nondiscrimination Policy

The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers, employees, and applicants for employment on the basis of race, color, national origin, age, disability, sex, gender identity, religion, reprisal, and where applicable, political beliefs, marital status, familial or parental status, sexual orientation, whether all or part of an individual's income is derived from any public assistance program, or protected genetic information. The Department prohibits discrimination in employment or in any program or activity conducted or funded by the Department. (Not all prohibited bases apply to all programs and/or employment activities.)

To File an Employment Complaint

If you wish to file an employment complaint, you must contact your agency's EEO Counselor (http://directives.sc.egov.usda.gov/33081.wba) within 45 days of the date of the alleged discriminatory act, event, or personnel action. Additional information can be found online at http://www.ascr.usda.gov/complaint_filing_file.html.

To File a Program Complaint

If you wish to file a Civil Rights program complaint of discrimination, complete the USDA Program Discrimination Complaint Form, found online at http://www.ascr.usda.gov/complaint_filing_cust.html or at any USDA office, or call (866) 632-9992 to request the form. You may also write a letter containing all of the information requested in the form. Send your completed complaint form or letter by mail to U.S. Department of Agriculture; Director, Office of Adjudication; 1400 Independence Avenue, S.W.; Washington, D.C. 20250-9419; by fax to (202) 690-7442; or by email to program.intake@usda.gov.

Persons with Disabilities

If you are deaf, are hard of hearing, or have speech disabilities and you wish to file either an EEO or program complaint, please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

If you have other disabilities and wish to file a program complaint, please see the contact information above. If you require alternative means of communication for

program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

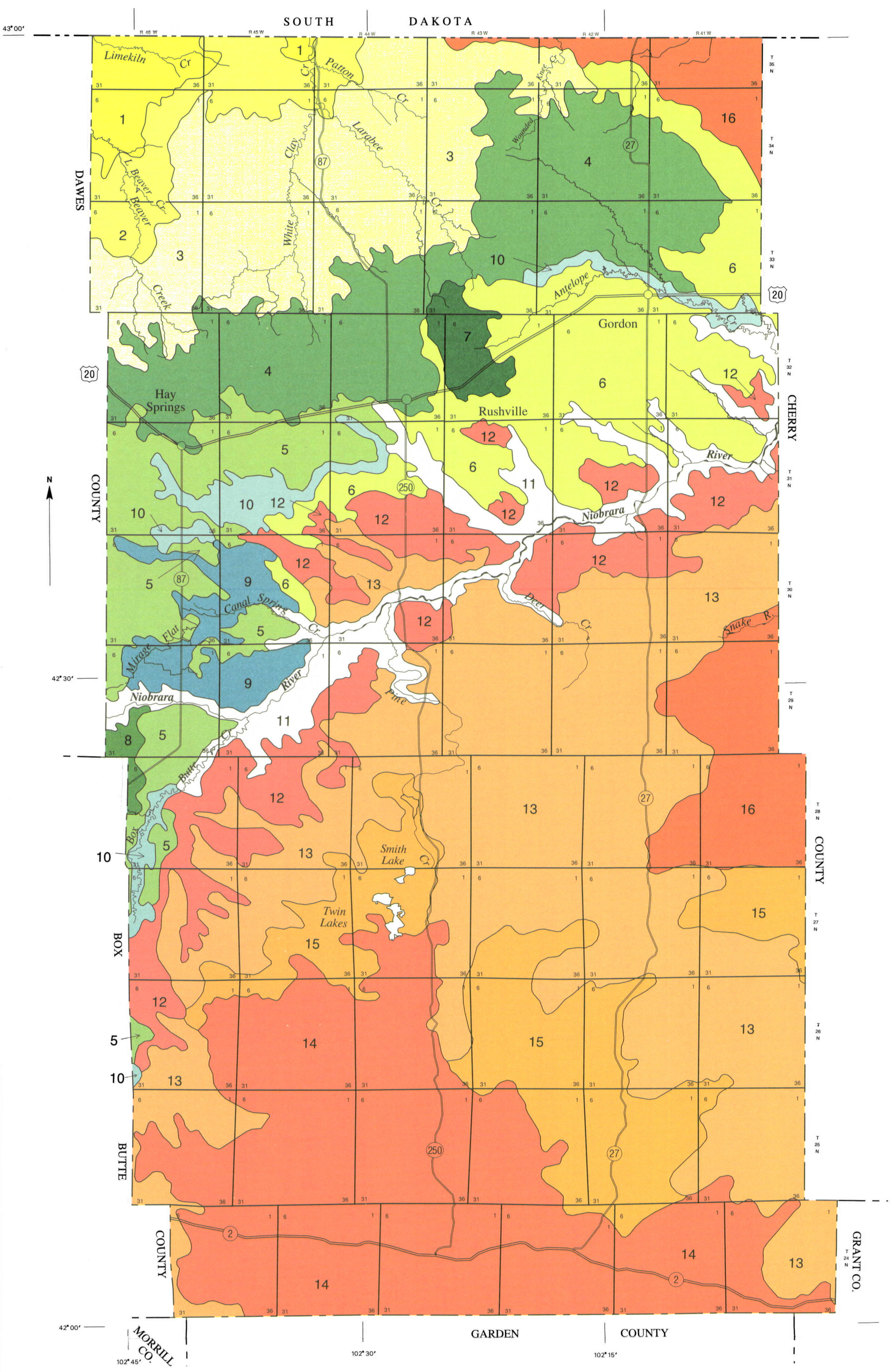
Supplemental Nutrition Assistance Program

For additional information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, call either the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish, or the State Information/Hotline Numbers (http://directives.sc.egov.usda.gov/33085.wba).

All Other Inquiries

For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (http://directives.sc.egov.usda.gov/33086.wba).

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



SOIL LEGEND*

AREAS OF SOILS FORMED IN MATERIAL WEATHERED FROM INTERBEDDED CHALK AND SHALE OR FROM SILTSTONE AND AREAS OF ROCK OUTCROP

1 Enning-Rock outcrop-Minnequa association

2 Thirtynine-Kadoka-Epping association

AREAS OF SOILS FORMED IN MATERIAL WEATHERED FROM CALCAREOUS SANDSTONE AND AREAS OF ROCK OUTCROP; IN THE PINE RIDGE AREA

3 Tassel-Ponderosa-Rock outcrop association

AREAS OF SOILS FORMED IN LOESS AND MATERIAL WEATHERED FROM CALCAREOUS SANDSTONE

4 Oglala-Alliance-Canyon association

5 Satanta-Canyon-Busher association

6 Tuthill-Keya association

7 Busher-Tassel association

8 Busher-Valent-Tassel association

AREAS OF SOILS FORMED IN MIXED LOESS AND ALLUVIUM AND AREAS OF ROCK OUTCROP

9 Keith, gravely substratum-Bridget-Johnstown association

10 Beckton-Lute association

11 Orpha-Calamus-Rock outcrop association

SOILS FORMED IN SANDY EOLIAN MATERIAL AND SANDY ALLUVIUM

12 Valent-Dailey association

13 Valent association

14 Valent-Wildhorse association

15 Valent-Els, calcareous-Hoffland association

16 Valentine-Tryon-Ipage association

*The units on this legend are described in the text under the heading "General Soil Map Units."

Compiled 1992

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

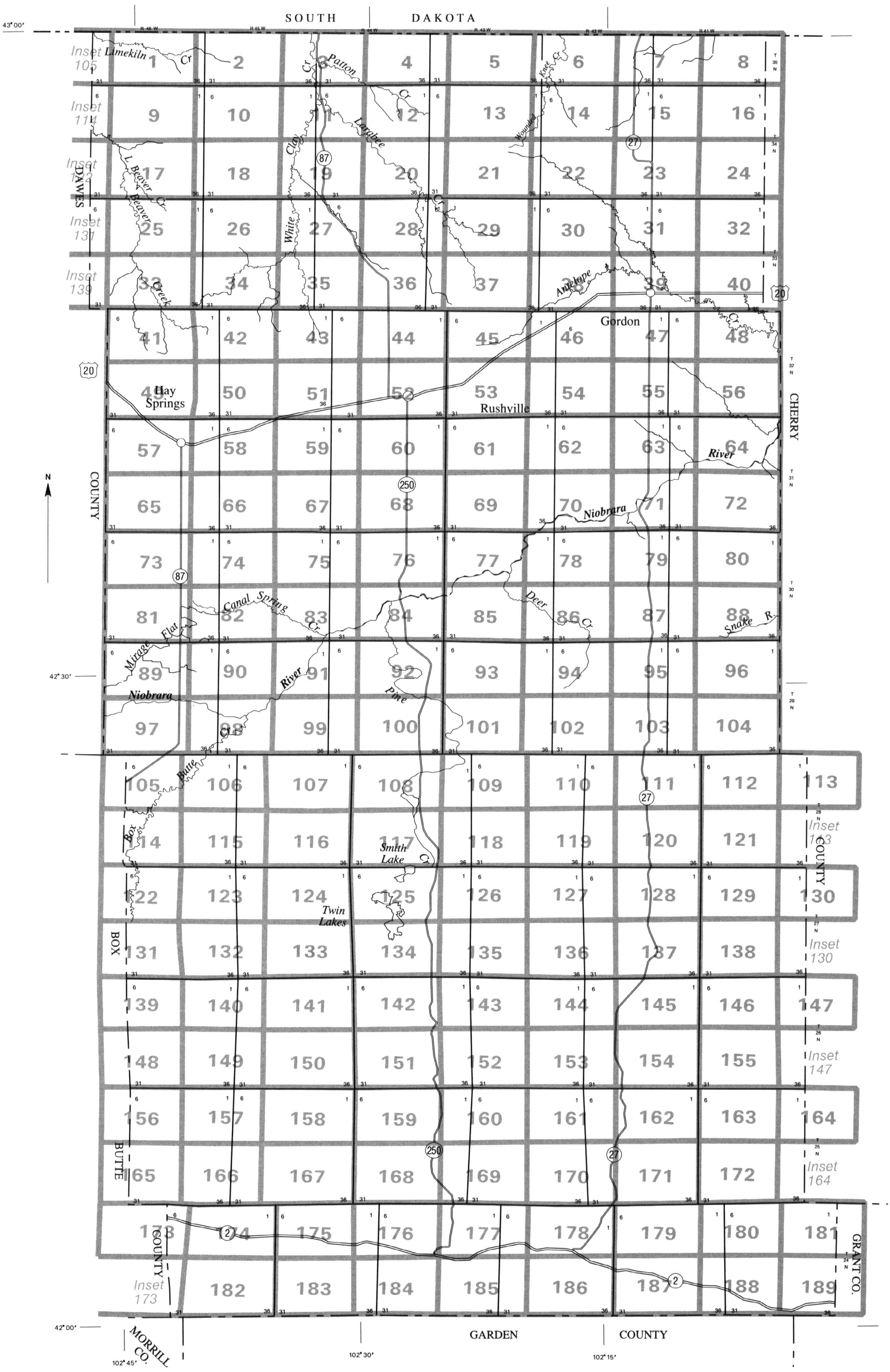
UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
IN COOPERATION WITH THE
UNIVERSITY OF NEBRASKA
CONSERVATION AND SURVEY DIVISION

GENERAL SOIL MAP
SHERIDAN COUNTY
NEBRASKA

Scale 1:316800

1 0 1 2 3 MILES

1 0 1 2 3 4 5 6 KILOMETERS



SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS
SHERIDAN COUNTY, NEBRASKA

Scale 1:316800

1 0 1 2 3 MILES

1 0 1 2 3 4 5 6 KILOMETERS

SOIL LEGEND

Map symbols consist of a combination of capital and lowercase letters. The first capital letter is the initial one of the soil name. The second letter is lowercase and separates map units whose names begin with the same letter. The third letter is a capital letter and indicates the class of slope. Symbols without a slope letter are for nearly level soils.

SYMBOL	NAME
Ac	Alliance loam, 0 to 1 percent slopes
AcB	Alliance loam, 1 to 3 percent slopes
AcC	Alliance loam, 3 to 6 percent slopes
An	Almeria loamy fine sand, channeled, 0 to 2 percent slopes
Bc	Bankard loamy fine sand, channeled, 0 to 2 percent slopes
Bd	Beckton silty loam, 0 to 2 percent slopes
Bf	Bolent loamy fine sand, 0 to 2 percent slopes
Bh	Bridget very fine sandy loam, 0 to 1 percent slopes
BhB	Bridget very fine sandy loam, 1 to 3 percent slopes
Bm	Bridget loam, 0 to 1 percent slopes
BnB	Bufton silty clay loam, 1 to 3 percent slopes
BnE	Bufton silty clay loam, 9 to 20 percent slopes
BoD	Bufton-Orella complex, 3 to 9 percent slopes
BsB	Busher fine sandy loam, 0 to 3 percent slopes
BsC	Busher fine sandy loam, 3 to 6 percent slopes
BsD	Busher fine sandy loam, 6 to 9 percent slopes
BvC	Busher-Tassel complex, 0 to 6 percent slopes
BvF	Busher-Tassel complex, 6 to 30 percent slopes
Ca	Calamus loamy fine sand, 0 to 2 percent slopes
Cr	Crowther loam, 0 to 1 percent slopes
Cs	Crowther loam, wet, 0 to 1 percent slopes
DuB	Dailey loamy fine sand, 0 to 3 percent slopes
DuD	Dailey loamy fine sand, 3 to 9 percent slopes
Dw	Duroc loam, 0 to 1 percent slopes
DwB	Duroc loam 1 to 3 percent slopes'
Ec	Els fine sand, calcareous, 0 to 2 percent slopes
Ef	Els, calcareous-Hoffland complex, 0 to 2 percent slopes
EgB	Els, calcareous-Ipage complex, 0 to 3 percent slopes
En	Els, calcareous-Tryon complex, 0 to 2 percent slopes
Es	Elsmere loamy fine sand, 0 to 2 percent slopes
EuE	Enning-Minnequa complex, 6 to 20 percent slopes
EvG	Enning-Rock outcrop complex, 9 to 40 percent slopes
EwG	Epping-Badland complex, 3 to 60 percent slopes
Fu	Fluvaquents, sandy, 0 to 1 percent slopes
Gg	Gannett loam, 0 to 1 percent slopes
Gh	Gannett loam, wet, 0 to 1 percent slopes
Hm	Hoffland fine sandy loam, 0 to 1 percent slopes
Hn	Hoffland find sandy loam, wet, 0 to 1 percent slopes
IpB	Ipage fine sand, 0 to 3 percent slopes
JgB	Jayem fine sandy loam, 0 to 3 percent slopes
JgC	Jayem fine sandy loam, 3 to 6 percent slopes
JgD	Jayem fine sandy loam, 6 to 9 percent slopes
Jo	Johnstown loam, 0 to 1 percent slopes
Kd	Kadoka silt loam, 0 to 2 percent slopes
KdC	Kadoka silt loam, 2 to 6 percent slopes
KdD	Kadoka silt loam, 6 to 9 percent slopes
Ke	Keith loam, 0 to 1 percent slopes
KeB	Keith loam, 1 to 3 percent slopes
KeC	Keith loam, 3 to 6 percent slopes
Kg	Keith loam, gravelly substratum, 0 to 1 percent slopes
KgB	Keith loam, gravelly substratum, 1 to 3 percent slopes
KgC	Keith loam, gravelly substratum, 3 to 6 percent slopes
Ky	Keya loam, 0 to 2 percent slopes

SYMBOL	NAME
La	Las Animas loam, 0 to 2 percent slopes
Lg	Lodgepole silt loam, 0 to 1 percent slopes
Lu	Lute loam, 0 to 2 percent slopes
MbC	Manvel silty clay loam, 2 to 6 percent slopes
Mc	Marlake fine sandy loam, 0 to 1 percent slopes
Mk	McCook loam, 0 to 2 percent slopes
Mm	McCook loam, channeled, 0 to 2 percent slopes
MxF	Mitchell-Epping complex, 9 to 30 percent slopes
My	Munjor fine sandy loam, 0 to 2 percent slopes
Mz	Munjor fine sandy loam, channeled, 0 to 2 percent slopes
OhC	Oglala-Canyon complex, 3 to 6 percent slopes
OhD	Oglala-Canyon complex, 6 to 11 percent slopes
OhF	Oglala-Canyon complex, 11 to 30 percent slopes
On	Onita silty clay loam, 0 to 1 percent slopes
OrF	Orella silty clay loam, 3 to 30 percent slopes
OvD	Orpha loamy fine sand, 3 to 9 percent slopes
OwF	Orpha-Niobrara complex, 9 to 30 percent slopes
OxG	Orpha-Rock outcrop complex, 20 to 60 percent slopes
PoC	Ponderosa very fine sandy loam, 3 to 6 percent slopes
PoD	Ponderosa very fine sandy loam, 6 to 9 percent slopes
PtF	Ponderosa-Tassel-Vetal complex, 6 to 30 percent slopes
RoB	Rosebud loam, 1 to 3 percent slopes
SnB	Satanta fine sandy loam, 0 to 3 percent slopes
SnC	Satanta fine sandy loam, 3 to 6 percent slopes
SnD	Satanta fine sandy loam, 6 to 11 percent slopes
SsD	Satanta-Canyon complex, 6 to 11 percent slopes
SsE	Satanta-Canyon complex, 11 to 20 percent slopes
TfG	Tassel-Rock outcrop complex, 9 to 70 percent slopes
TgG	Tassel-Ponderosa-Rock outcrop association, 9 to 70 percent slopes
ThB	Thirtynine loam, 1 to 3 percent slopes
ThC	Thirtynine loam, 3 to 6 percent slopes
ThD	Thirtynine loam, 6 to 9 percent slopes
To	Tryon fine sandy loam, 0 to 1 percent slopes
Tp	Tryon fine sandy loam, wet, 0 to 1 percent slopes
TtB	Tuthill loamy fine sand, 0 to 3 percent slopes
TtD	Tuthill loamy fine sand, 3 to 9 percent slopes
TwB	Tuthill fine sandy loam, 0 to 3 percent slopes
TwC	Tuthill fine sandy loam, 3 to 6 percent slopes
TwD	Tuthill fine sandy loam 6 to 11 percent slopes
VaB	Valent fine sand, 0 to 3 percent slopes
VaD	Valent fine sand, 3 to 9 percent slopes
VaE	Valent fine sand, rolling
VaF	Valent complex, rolling and hilly
VaG	Valent fine sand, hilly
VeB	Valent loamy fine sand, 0 to 3 percent slopes
VeD	Valent loamy fine sand, 3 to 9 percent slopes
VnD	Valentine fine sand, 3 to 9 percent slopes
VnE	Valentine fine sand, rolling
VnF	Valentine complex, rolling and hilly
VnG	Valentine fine sand, hilly
VsB	Vetal loamy fine sand, 0 to 3 percent slopes
Vt	Vetal fine sandy loam, 0 to 2 percent slopes
WrB	Wildhorse fine sand, 0 to 3 percent slopes
WsB	Wildhorse-Hoffland complex, 0 to 3 percent slopes
WtB	Wildhorse-Ipage, calcareous complex, 0 to 3 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County
- Reservation (national forest or park, state forest or park, and large airport)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool — Davis Airstrip; FLOOD POOL LINE

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Federal — 410
- State — 52
- County, farm or ranch — 378

RAILROAD

DAMS

- Medium or small — water; w

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Located object (label) — Tower
- Windmill

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
- Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water; w
- Intermittent — int; i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp (up to 3 acres)
- Spring
- Wet spot (up to 3 acres)

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — OhD DuB

ESCARPMENTS

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK (up to 3 acres)

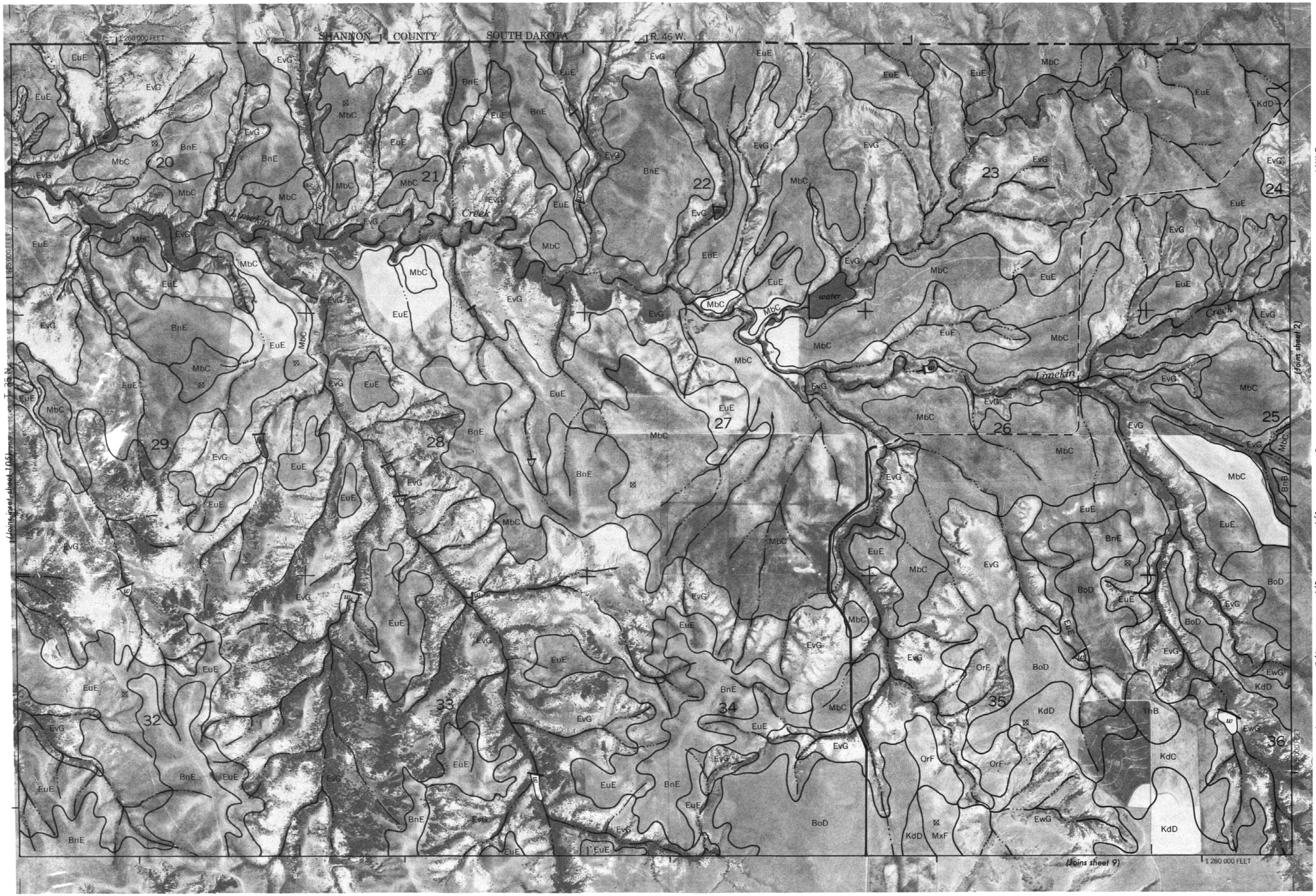
MISCELLANEOUS

- Blowout (up to 3 acres)
- Clay spot (up to 3 acres)
- Gravelly spot (up to 3 acres)
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale) (up to 3 acres)
- Saline spot (up to 3 acres)
- Sandy spot (up to 3 acres)
- Severely eroded spot (up to 3 acres)
- Livestock watering facility
- Cut area (up to 3 acres)

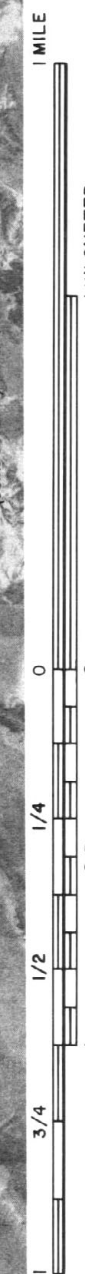
1

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 1



N



Scale 1:20000

SHERIDAN COUNTY, NEBRASKA NO. 2

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

3

N

1 MILE

1 KILOMETER

Scale 1:20000

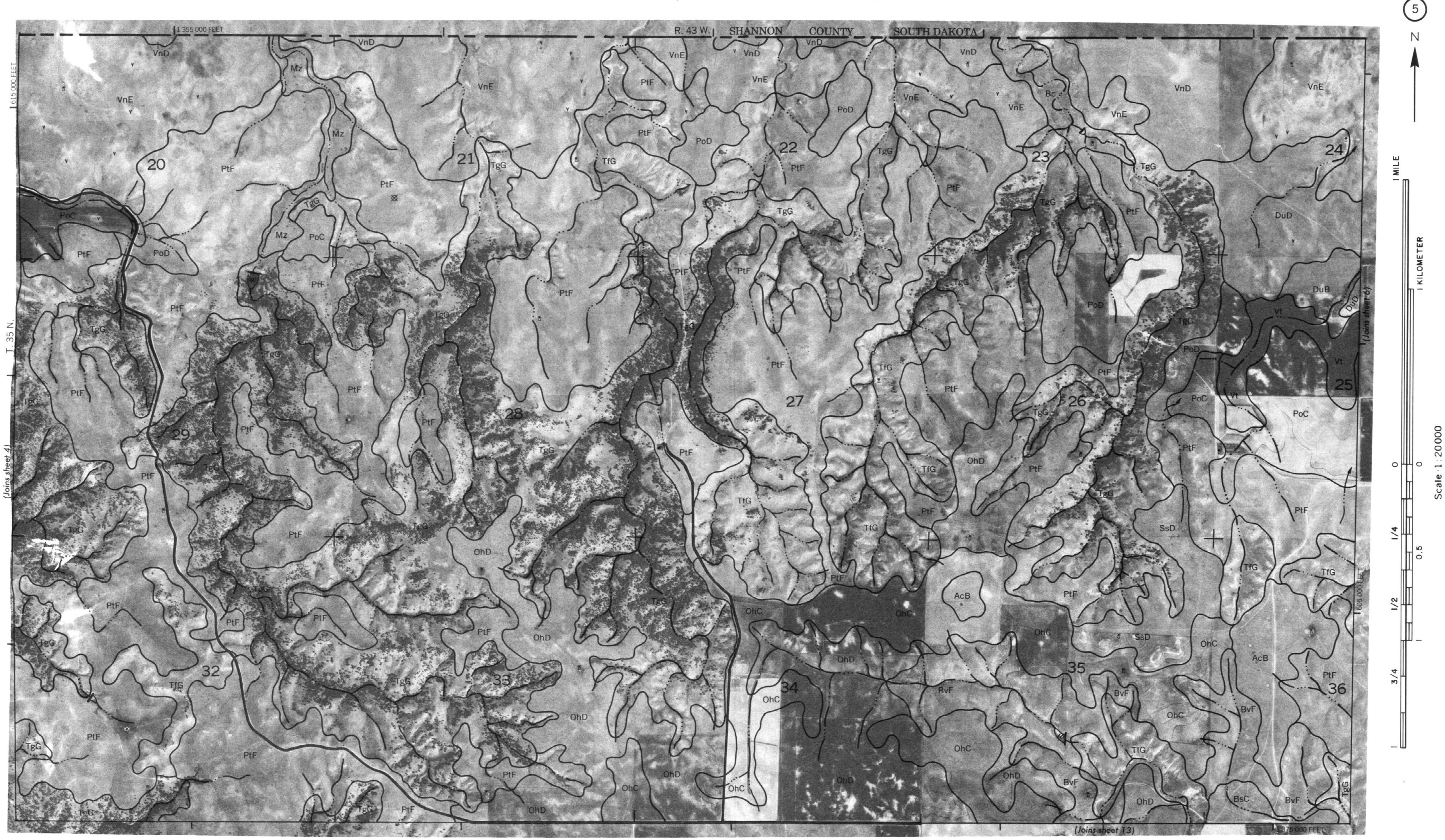
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 3

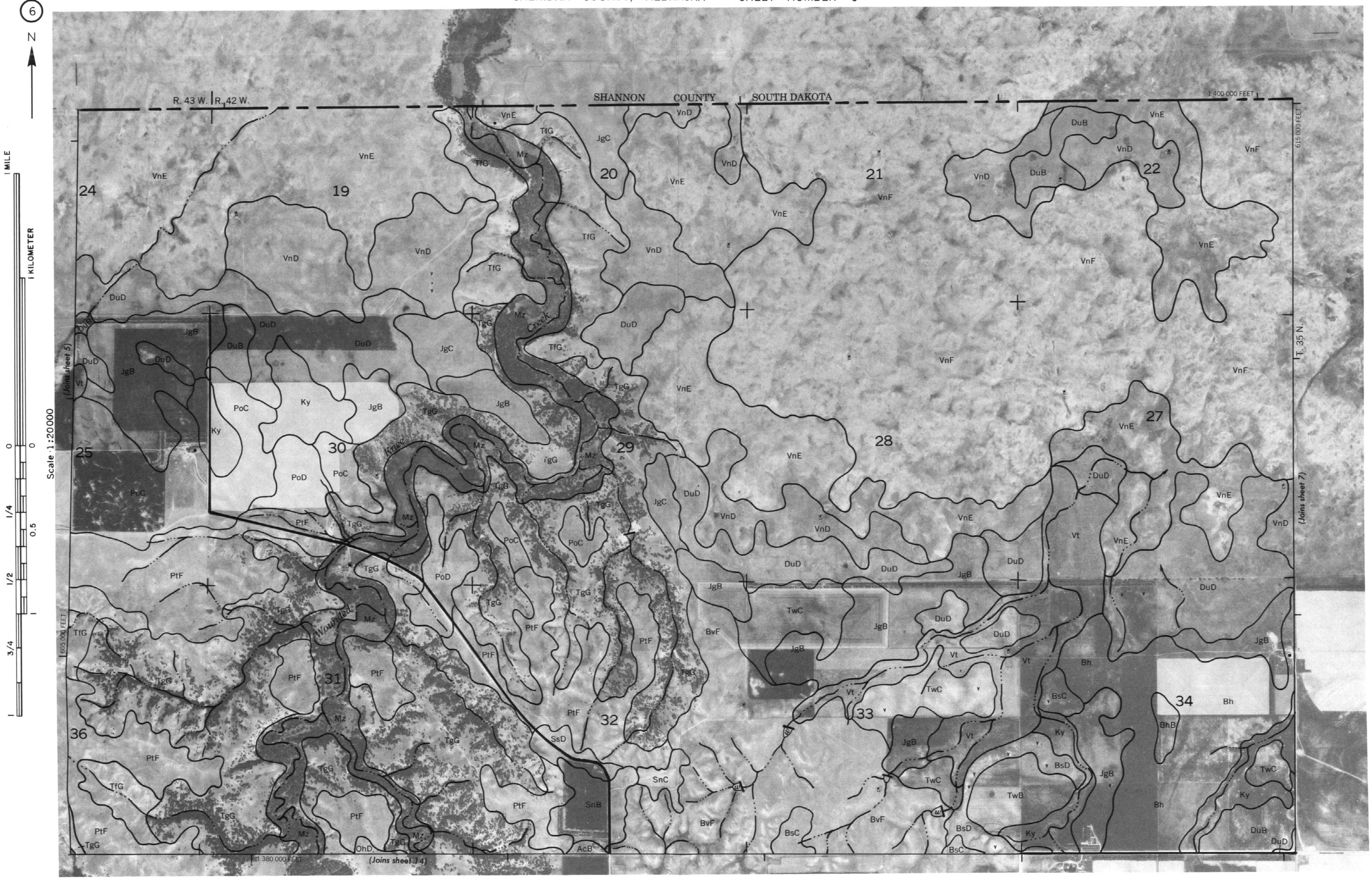
SHERIDAN COUNTY, NEBRASKA — SHEET NUMBER 4

SHERIDAN COUNTY, NEBRASKA NO. 4

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

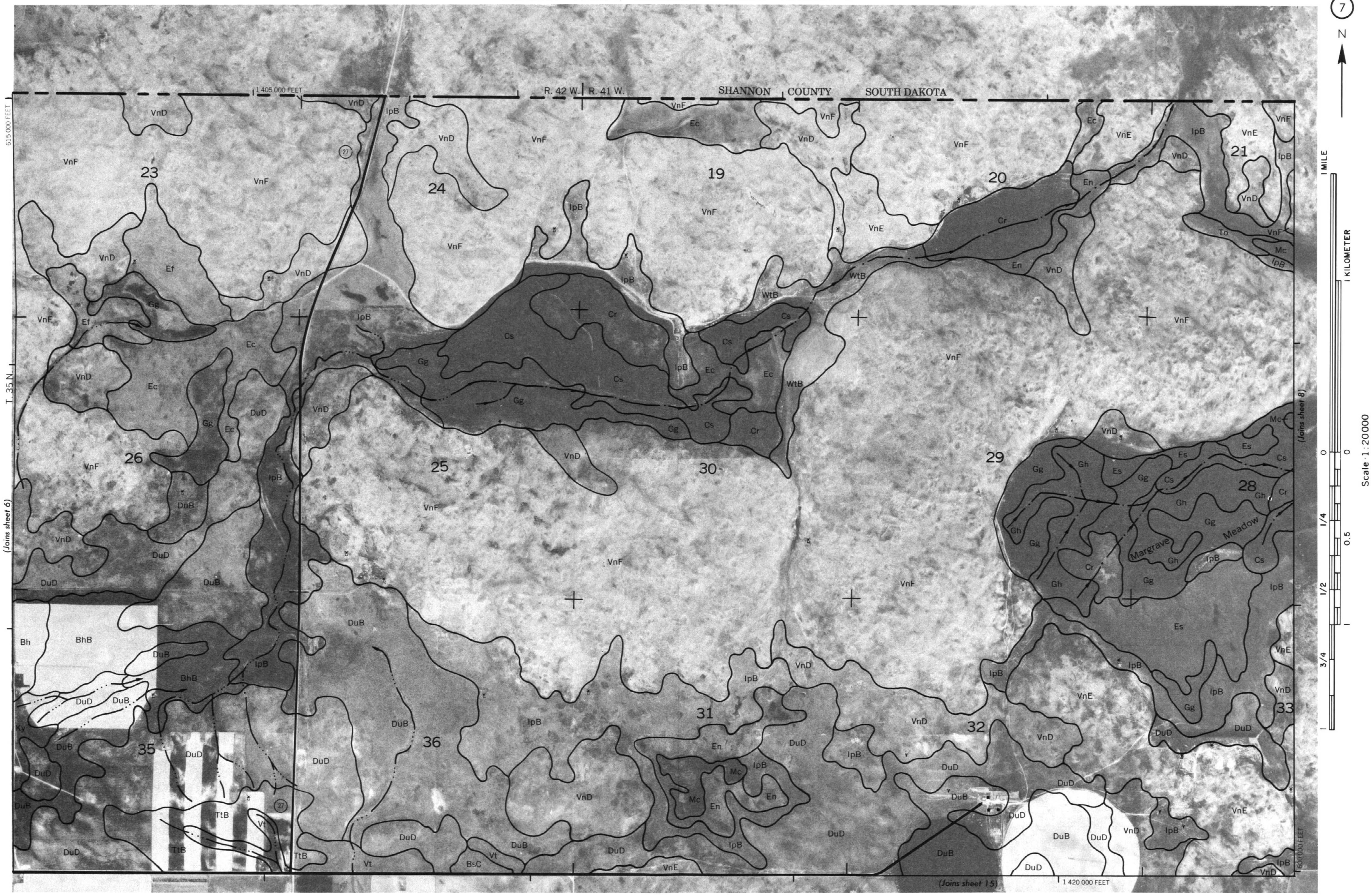


SHERIDAN COUNTY, NEBRASKA NO. 6

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 7



SHERIDAN COUNTY, NEBRASKA — SHEET NUMBER 8

N

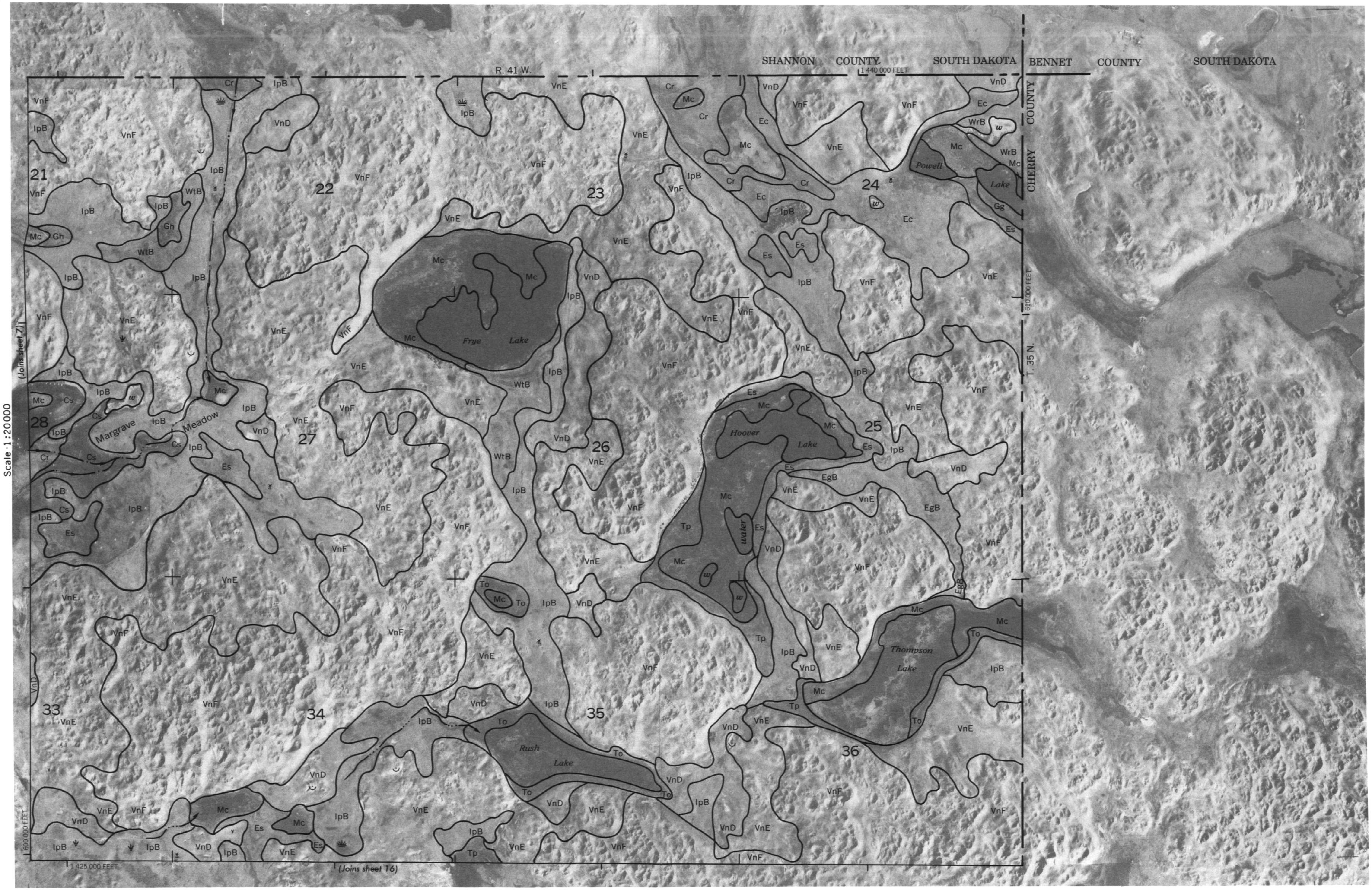
1 MILE

1 KILOMETER

Scale 1:20000

0 1/4 1/2 3/4 1

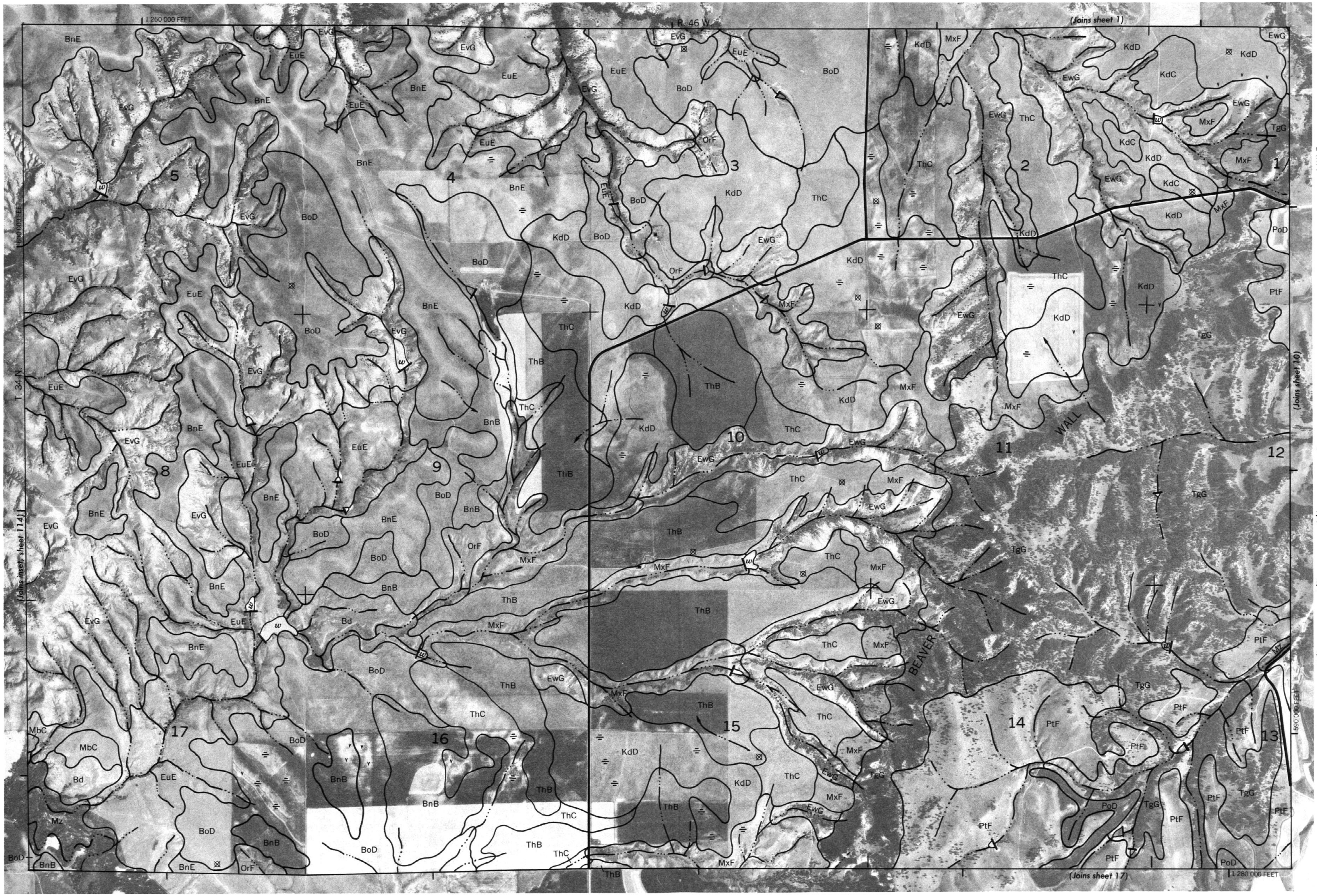
0 0.5 1



SHERIDAN COUNTY, NEBRASKA NO. 8

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

9



N

1 MILE

1 KILOMETER

0 1/4 1/2 3/4 1

0 0.5 1

Scale 1:20000

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 9

SHERIDAN COUNTY, NEBRASKA — SHEET NUMBER 10

N

1 MILE

1 KILOMETER

Scale 1:20000

0 1/4 1/2 3/4 1

0 0.5 1

SHERIDAN COUNTY, NEBRASKA NO. 10

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

11

N

1 MILE

1 KILOMETER

0 1/4 1/2 3/4 1

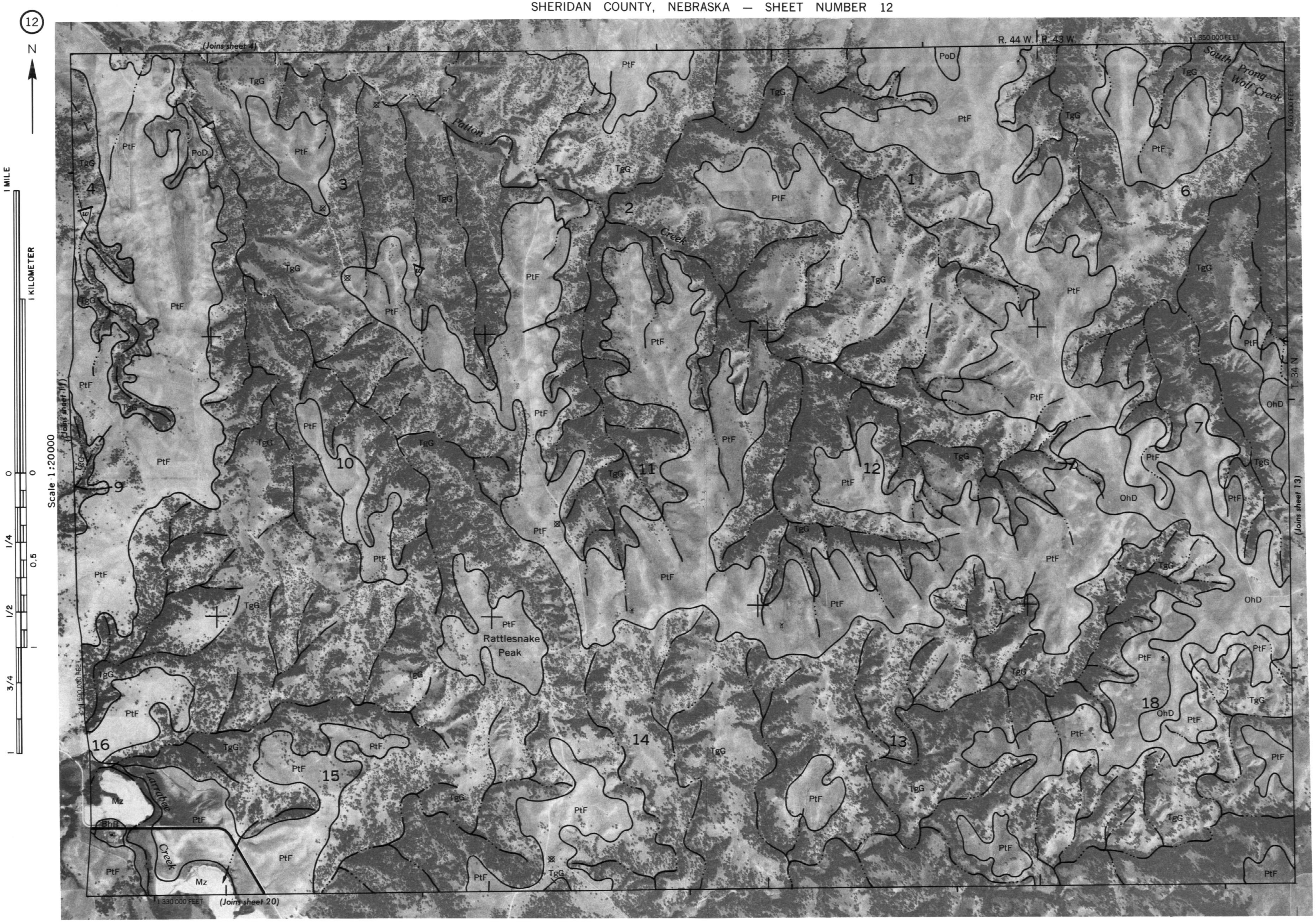
0 0.5 1

Scale 1:20000

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

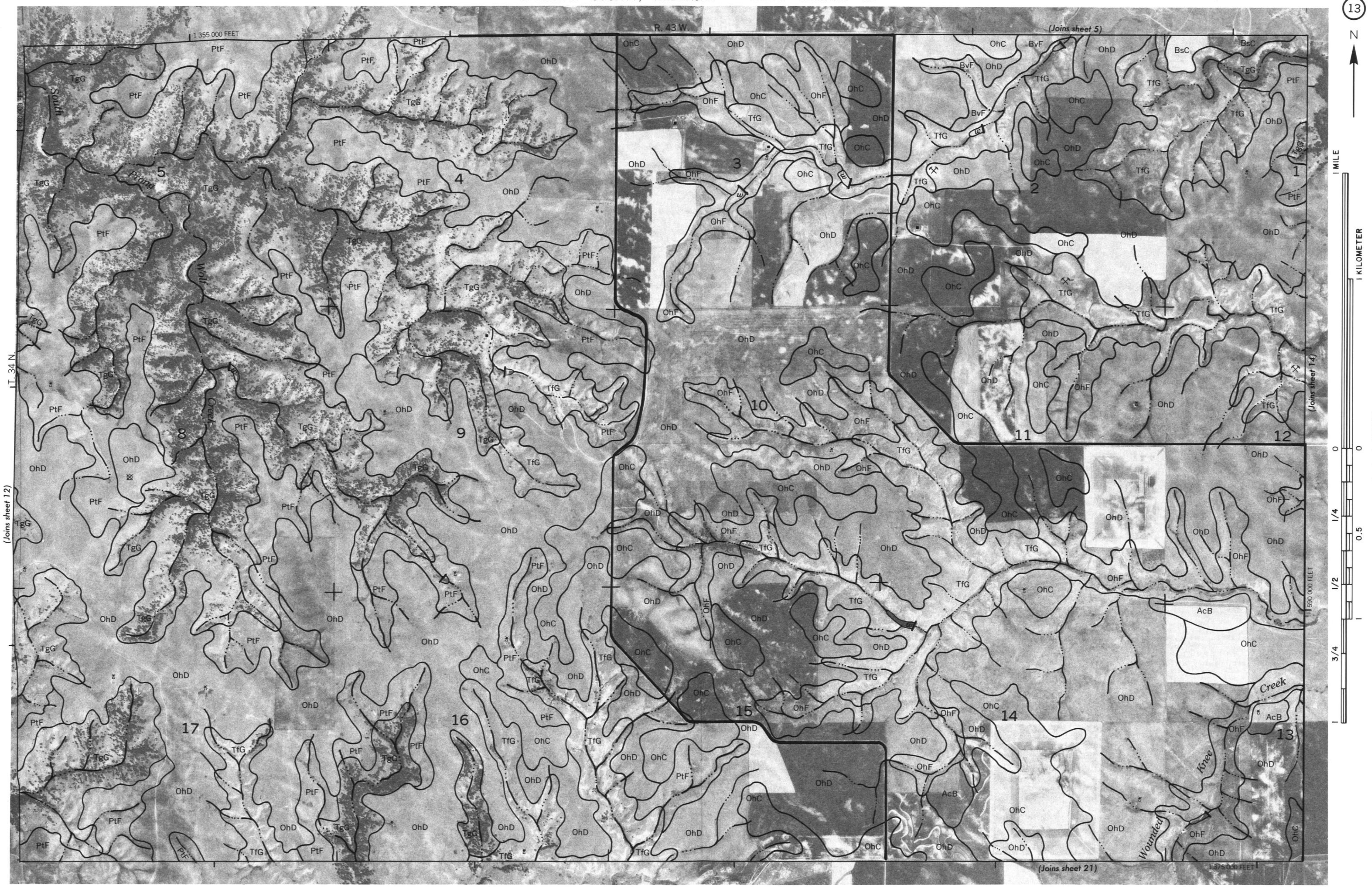
SHERIDAN COUNTY, NEBRASKA NO. 11

SHERIDAN COUNTY, NEBRASKA — SHEET NUMBER 12



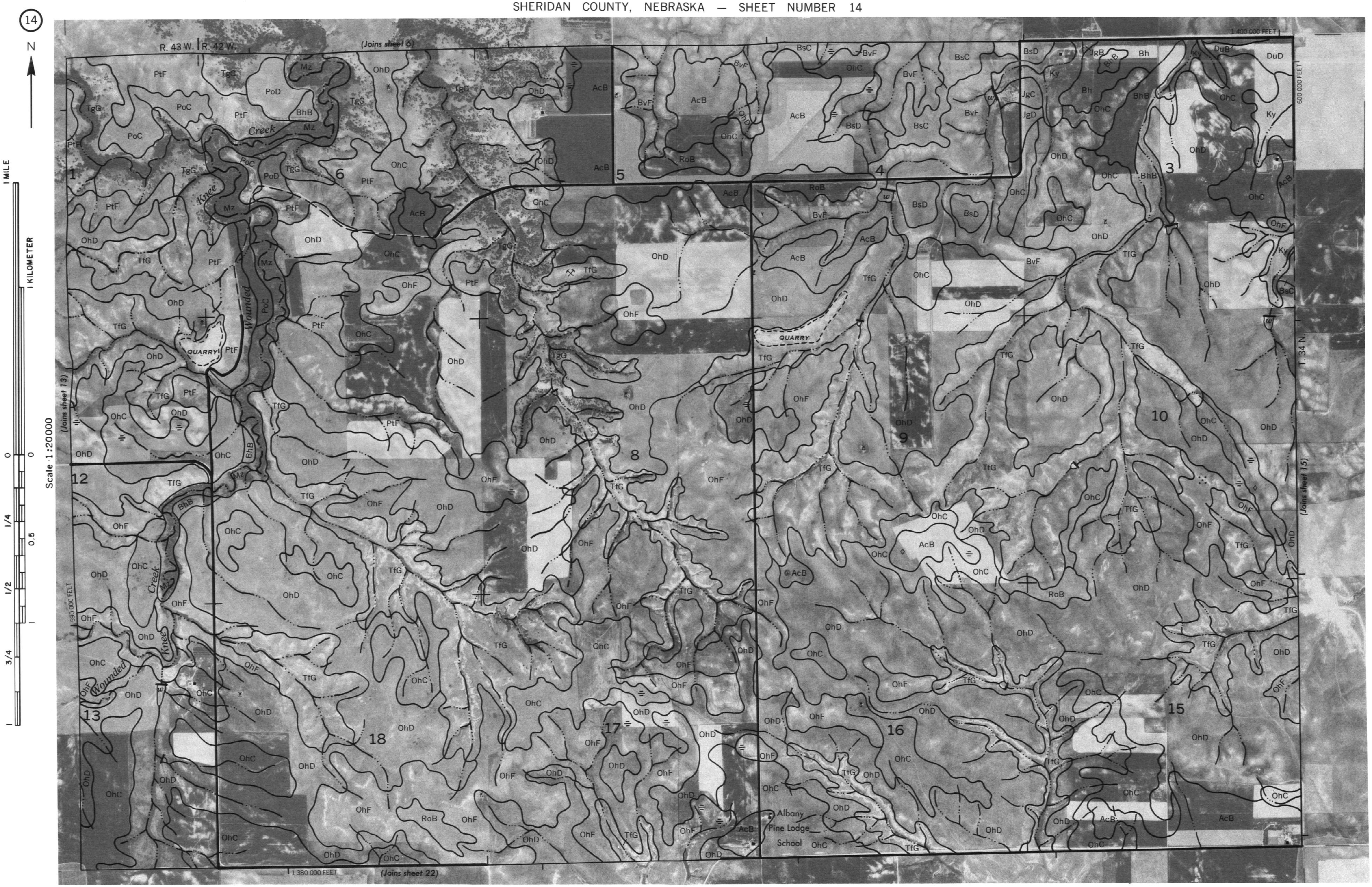
SHERIDAN COUNTY, NEBRASKA NO. 12

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



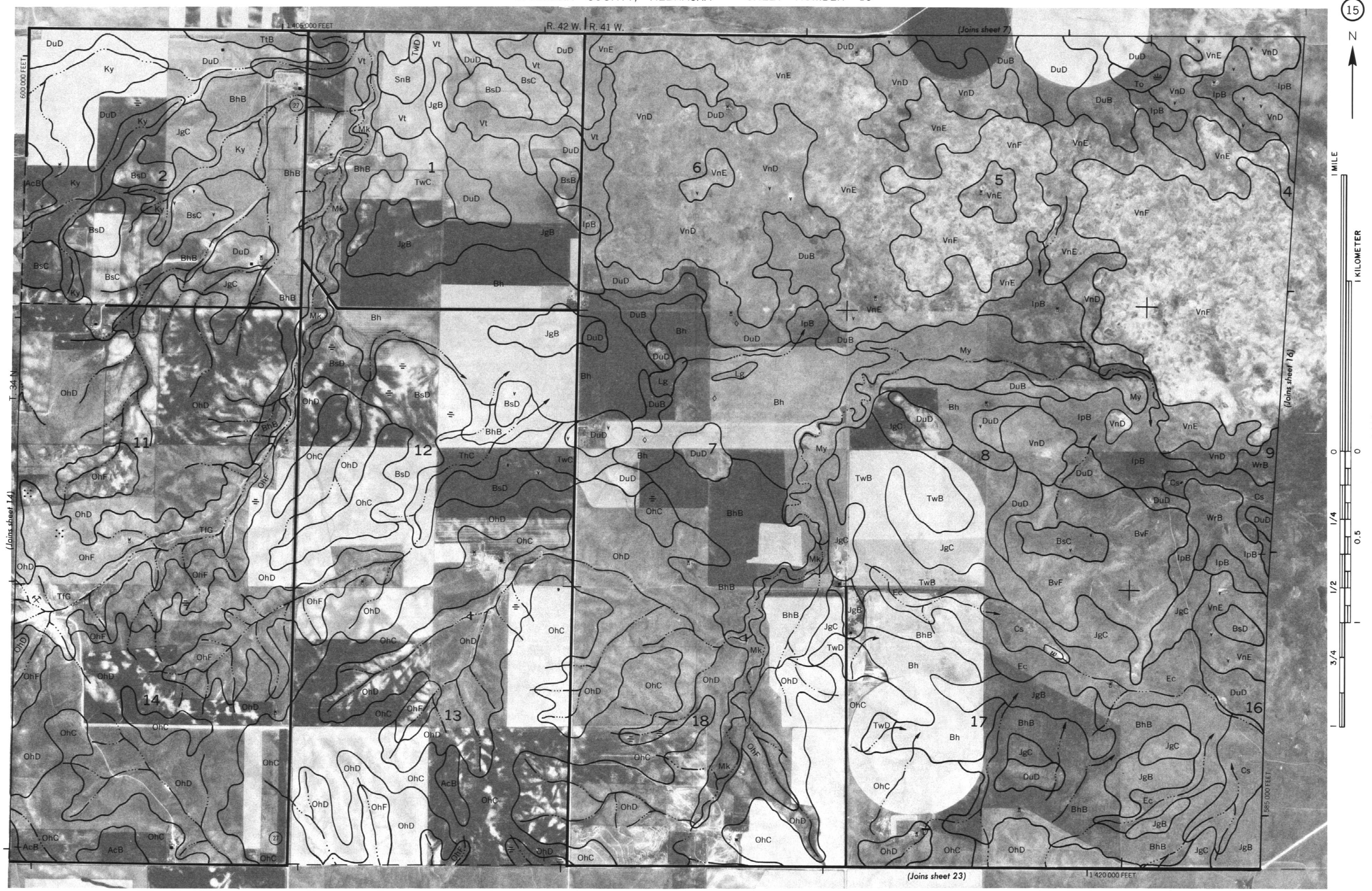
SHERIDAN COUNTY, NEBRASKA NO. 13

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



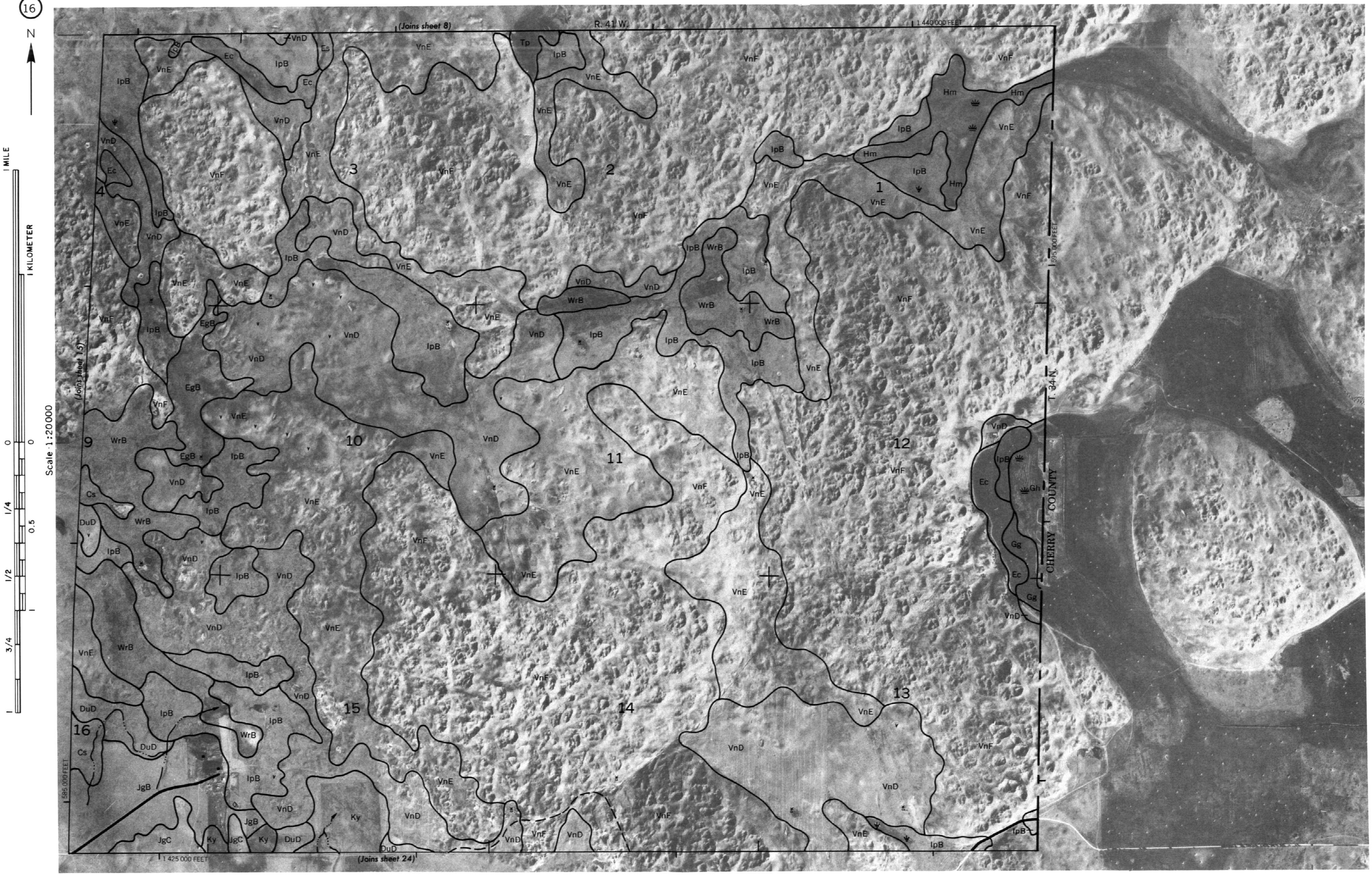
SHERIDAN COUNTY, NEBRASKA NO. 14

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



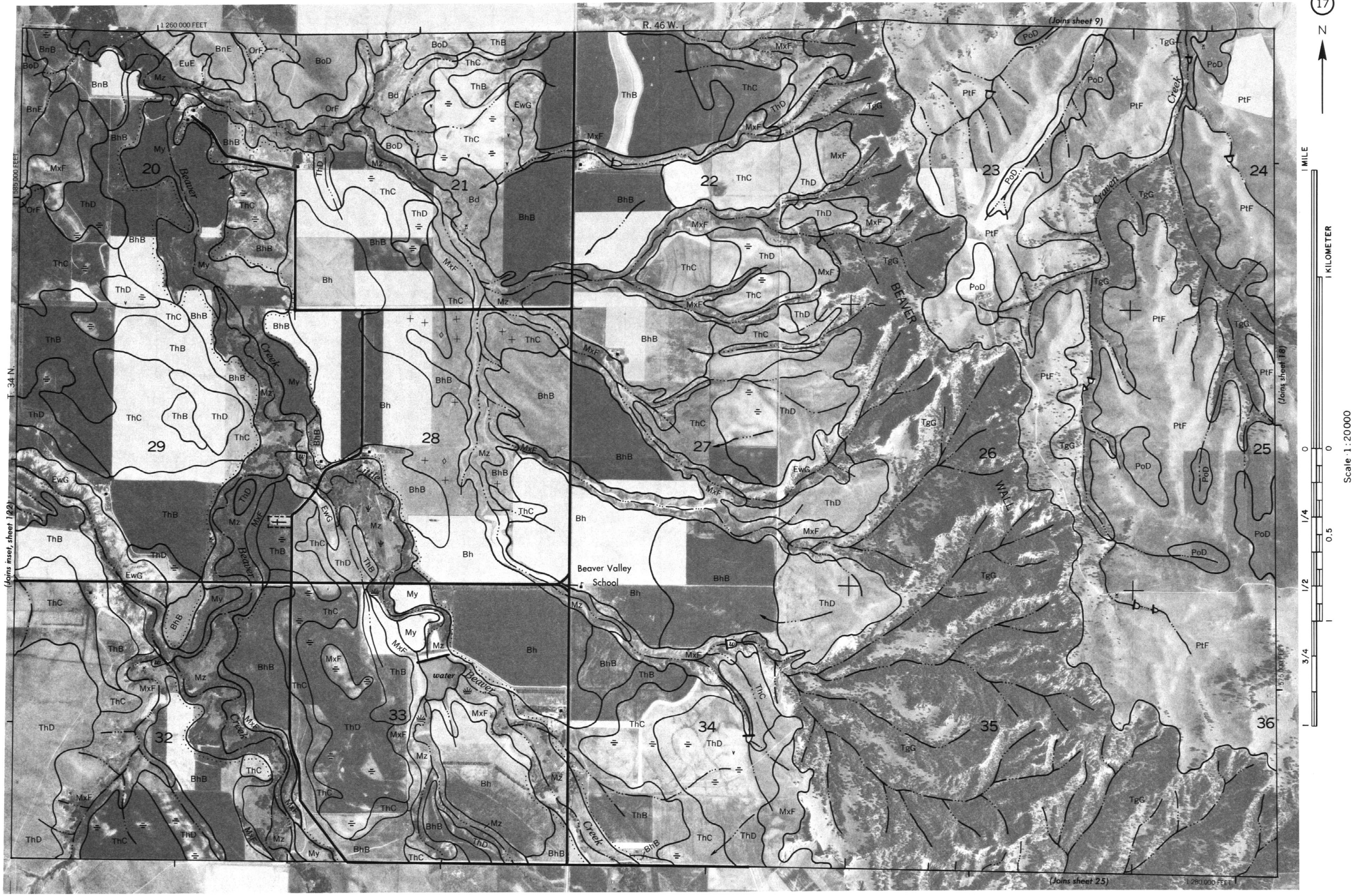
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 15



SHERIDAN COUNTY, NEBRASKA NO. 16

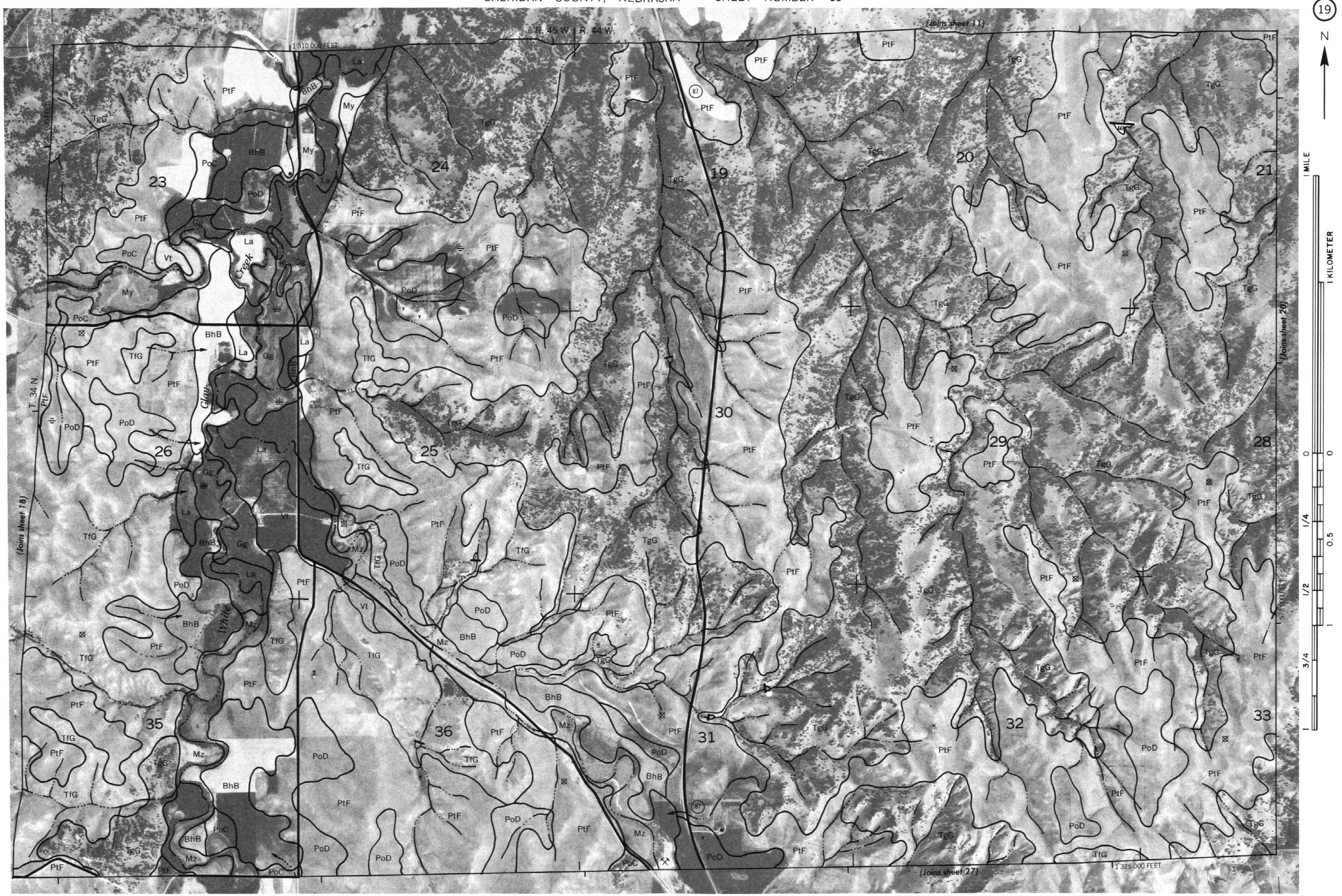
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned



SHERIDAN COUNTY, NEBRASKA NO. 17
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

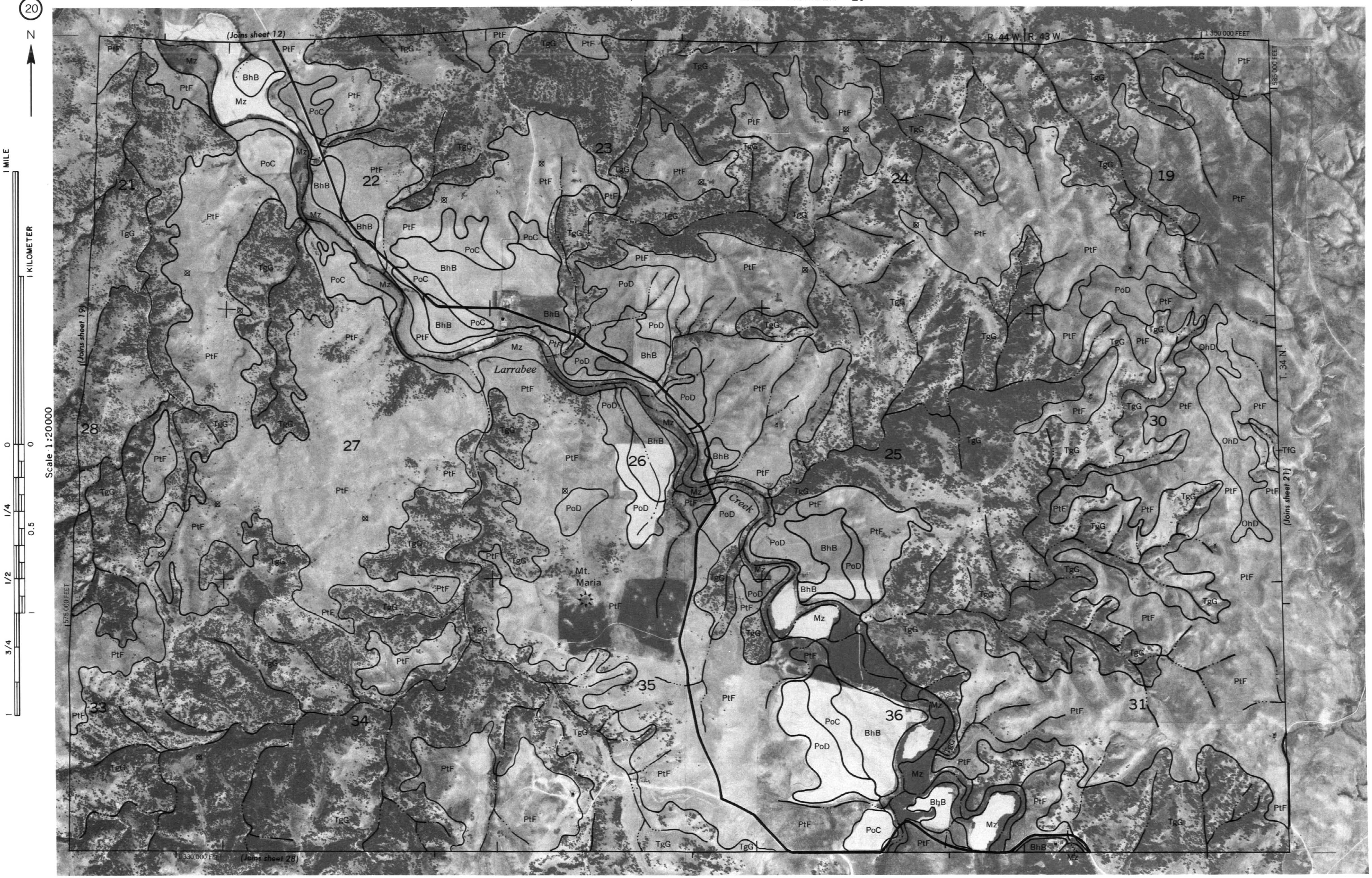
SHERIDAN COUNTY, NEBRASKA NO. 18

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



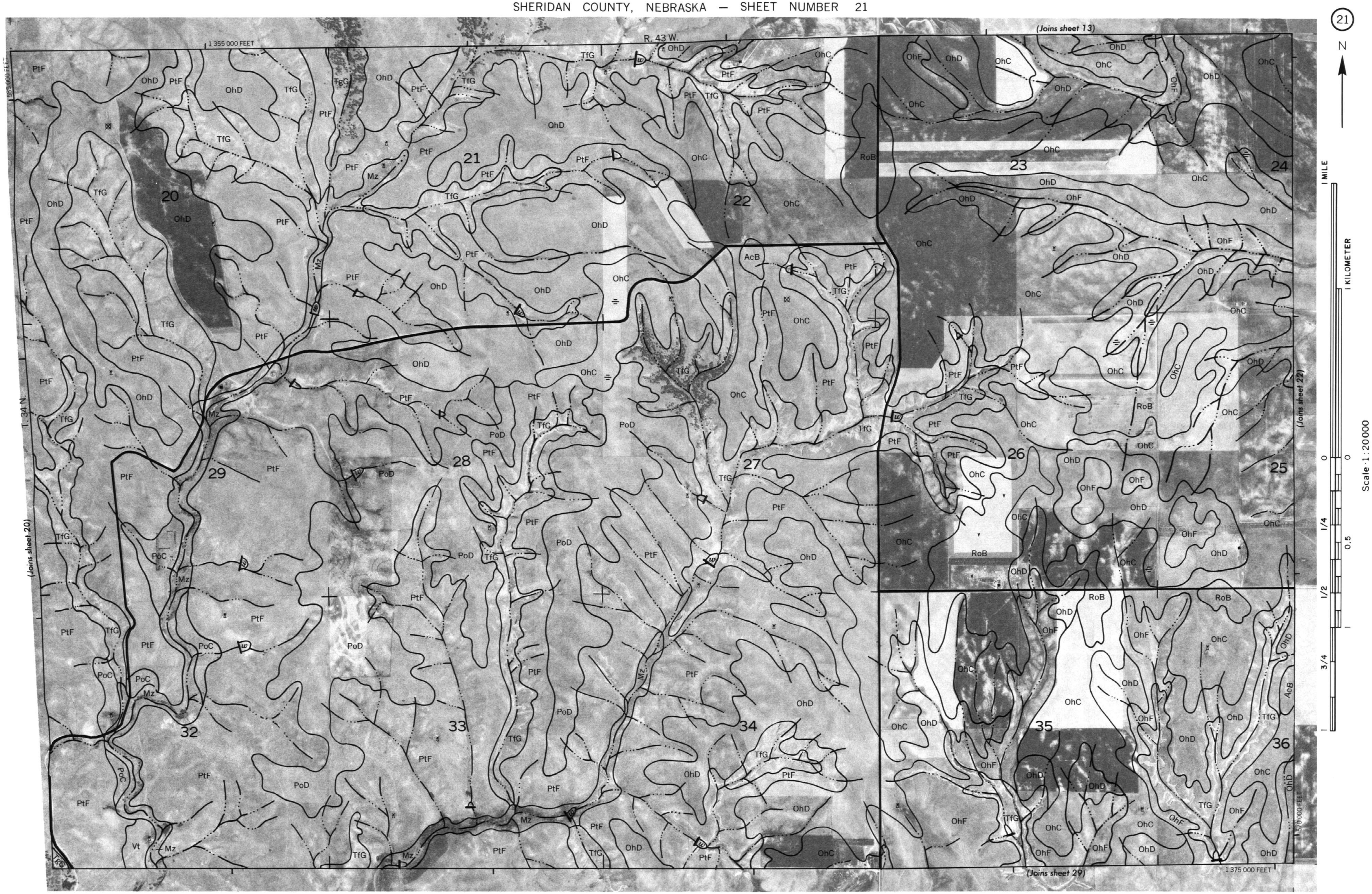
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 19



SHERIDAN COUNTY, NEBRASKA NO. 20

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 21

22

N

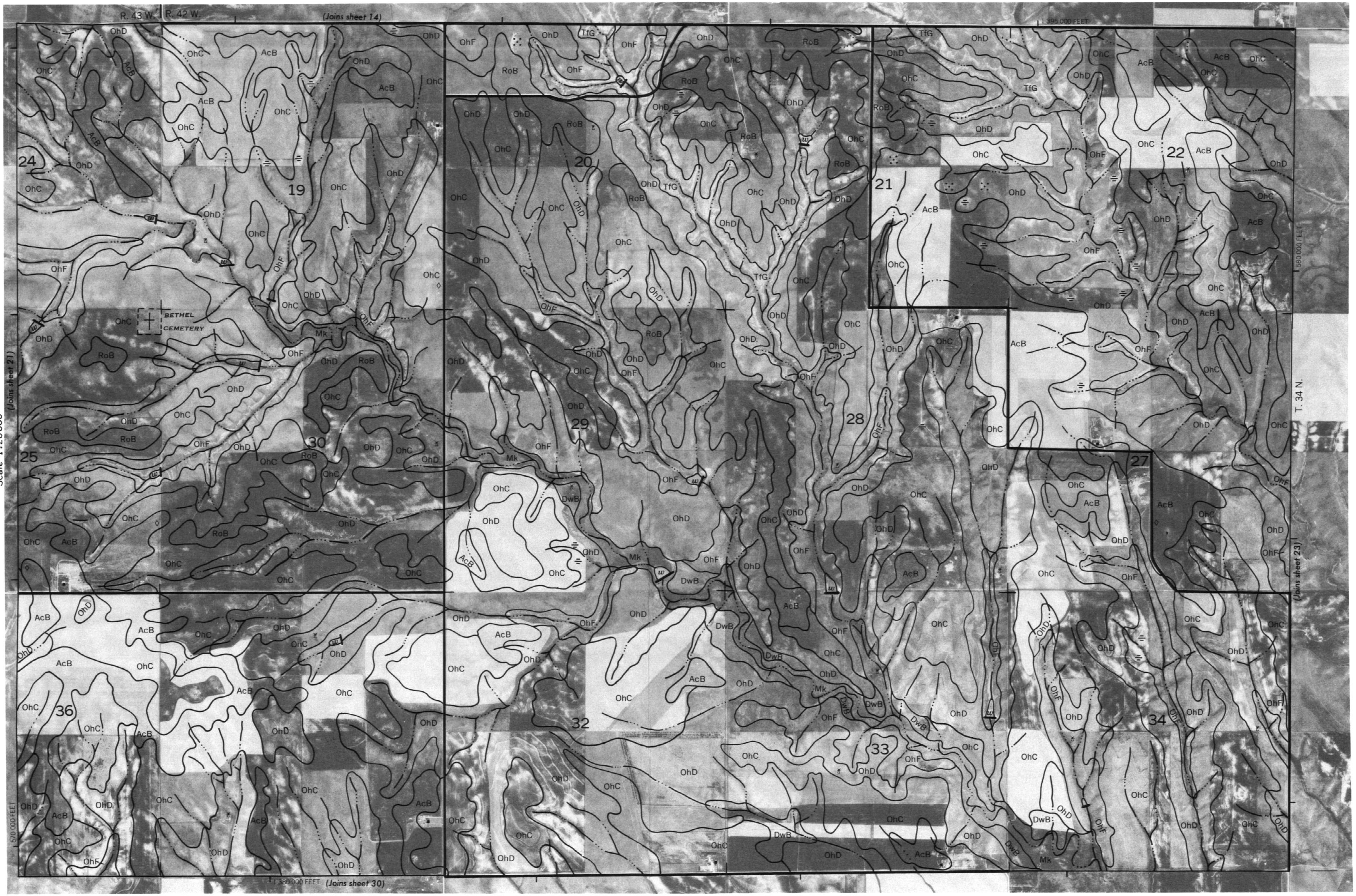
1 MILE

1 KILOMETER

Scale 1:20000

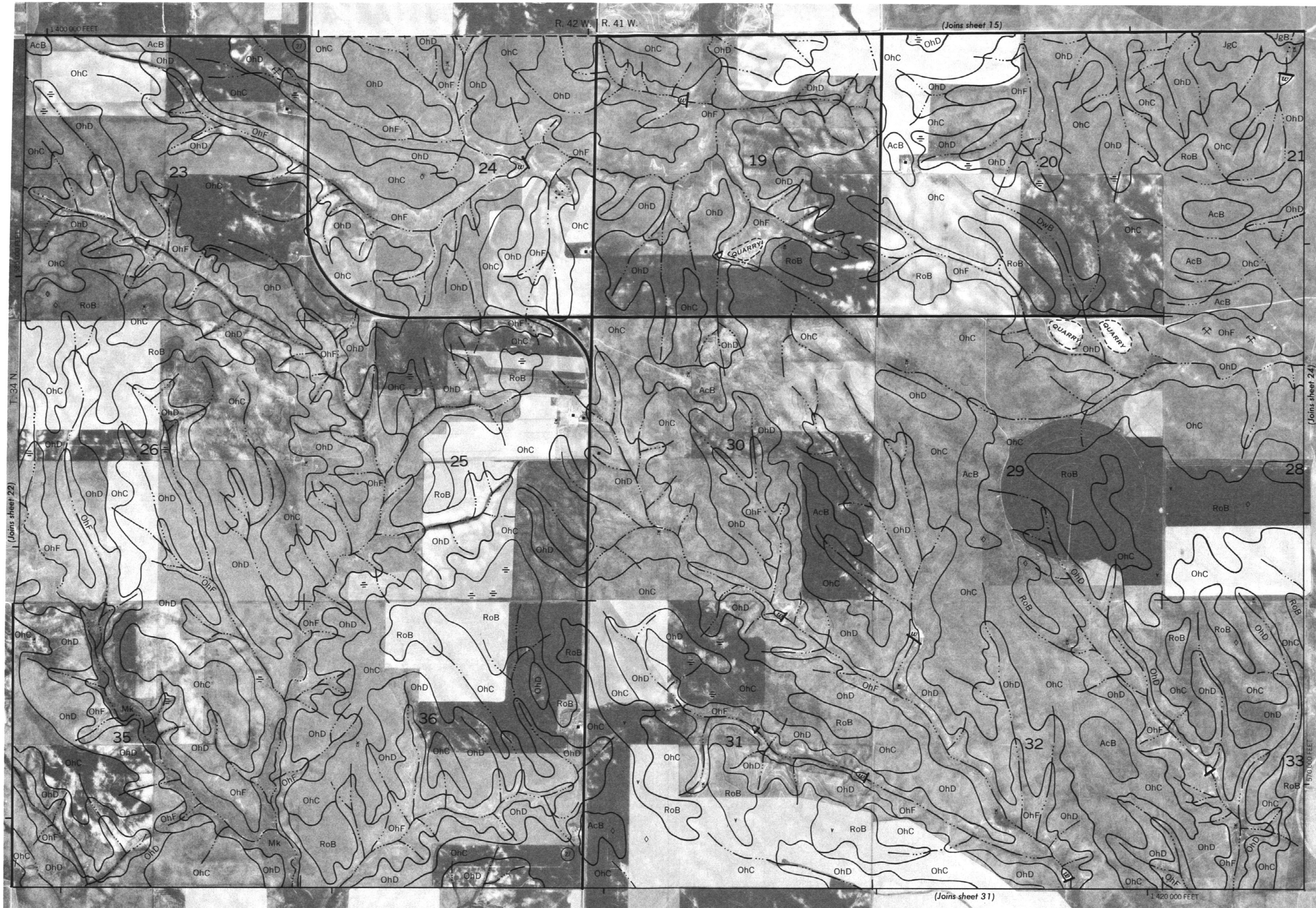
0 1/4 1/2 3/4 1

0 0.5 1



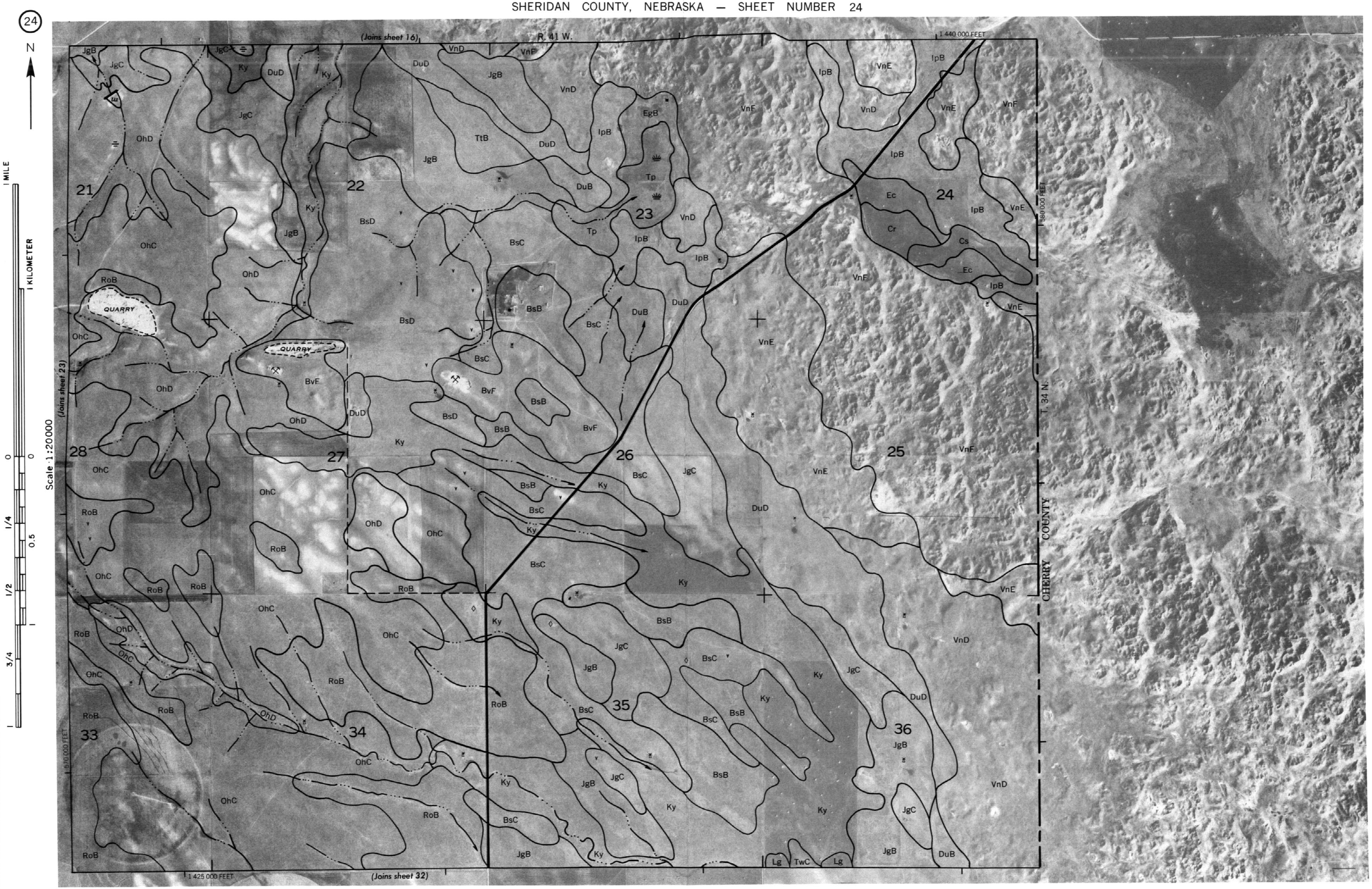
SHERIDAN COUNTY, NEBRASKA NO. 22

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 23

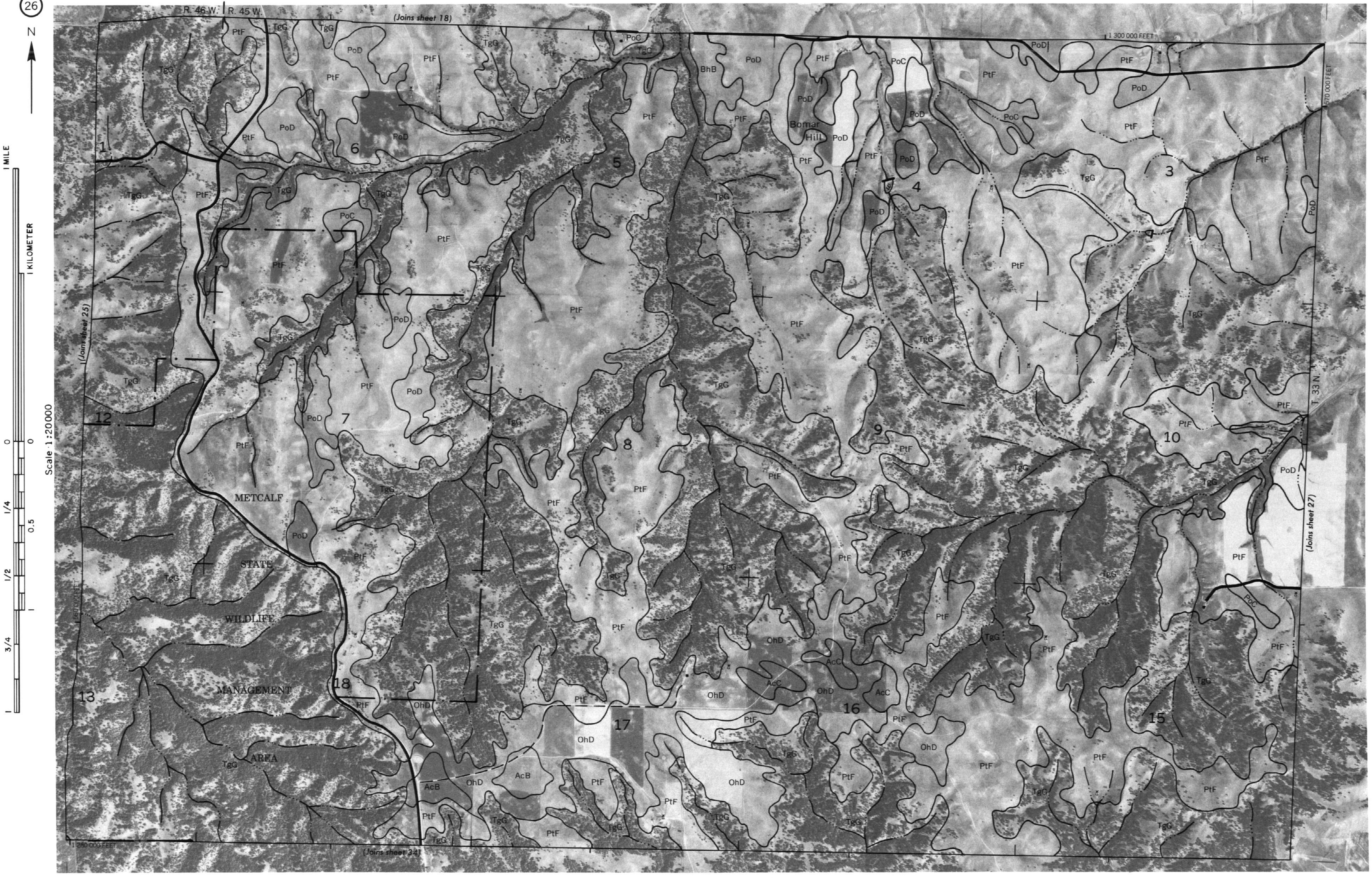


SHERIDAN COUNTY, NEBRASKA NO. 24

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

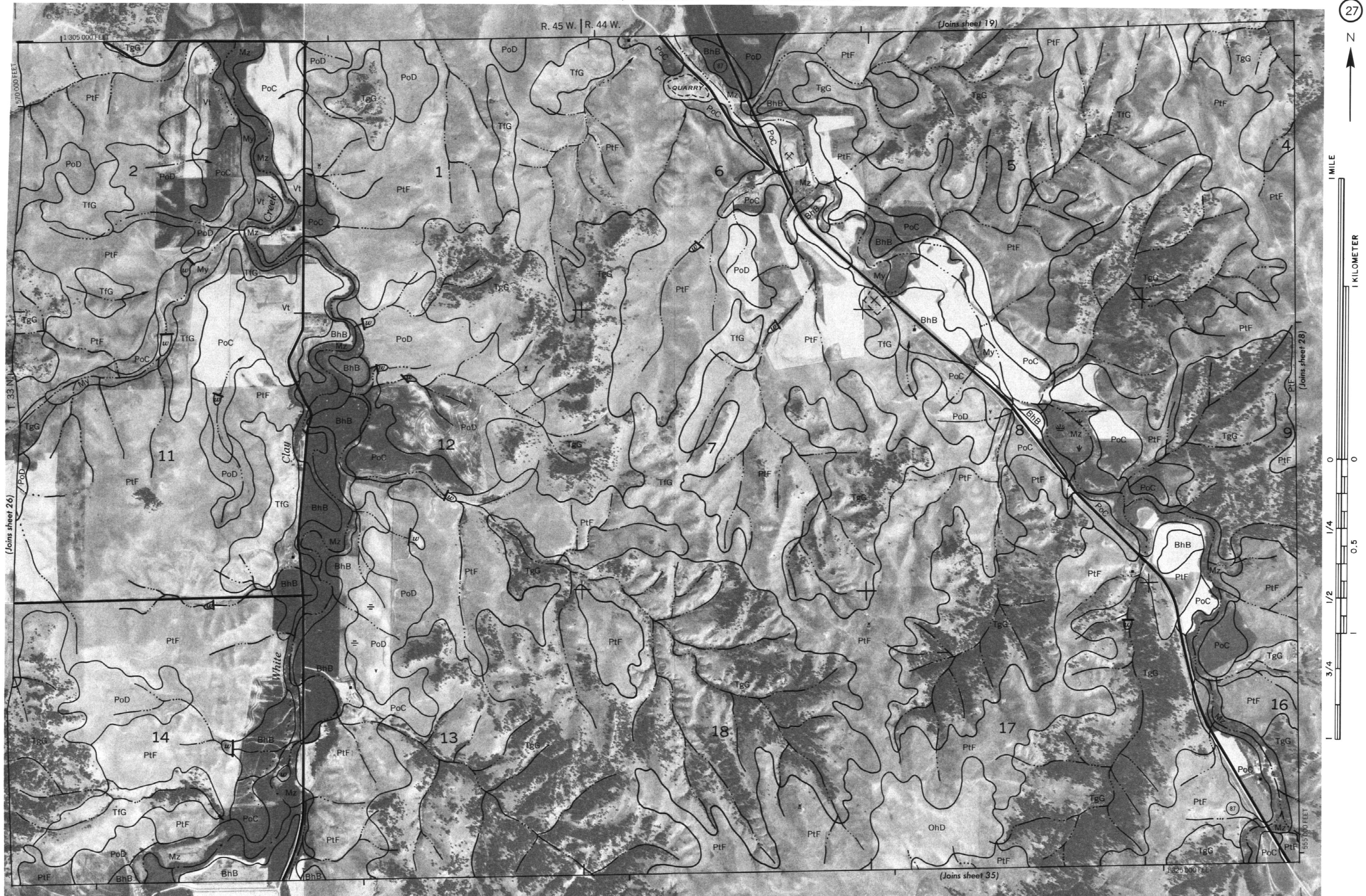
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 25



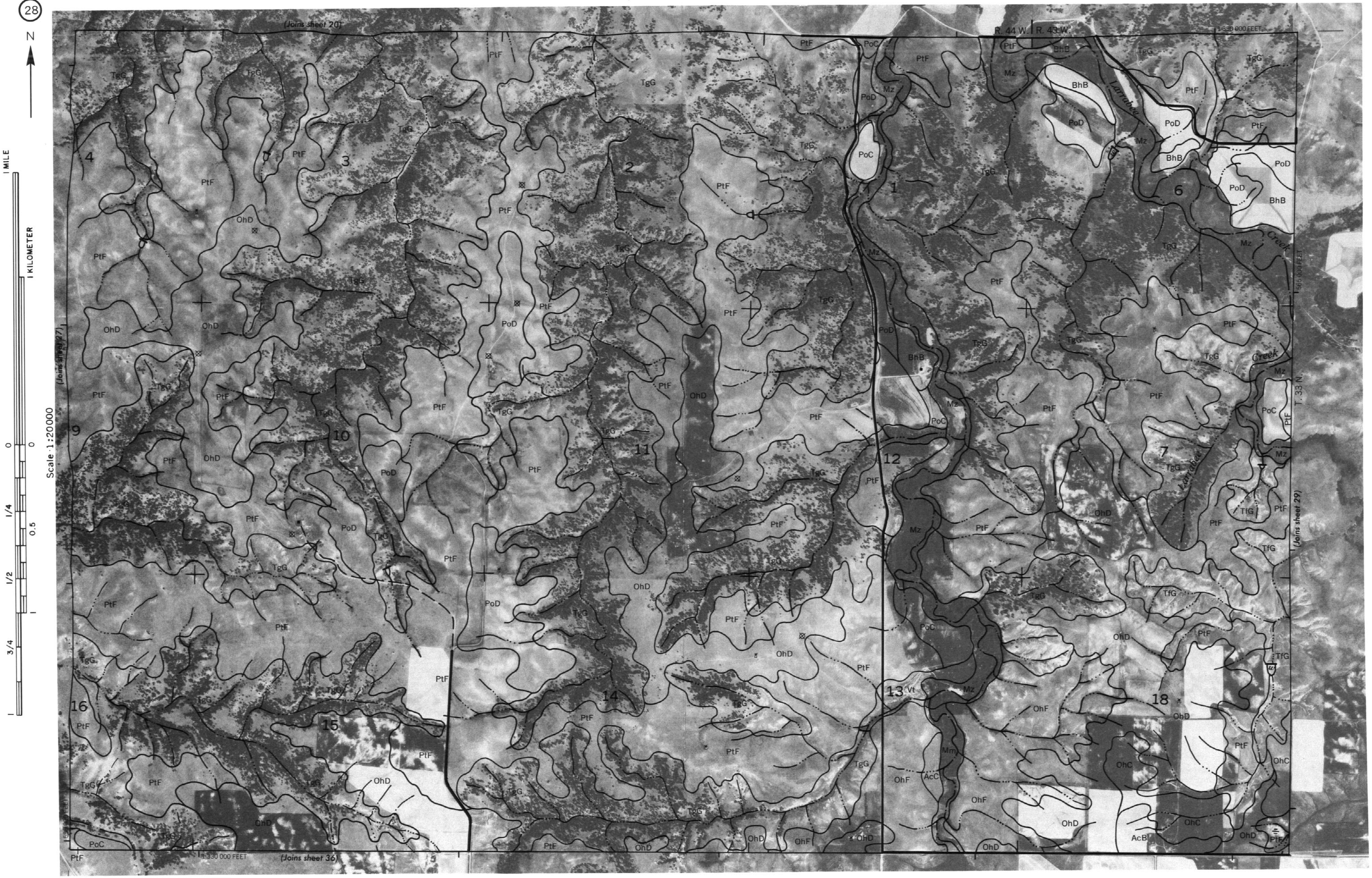
SHERIDAN COUNTY, NEBRASKA NO. 26

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned



This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 27

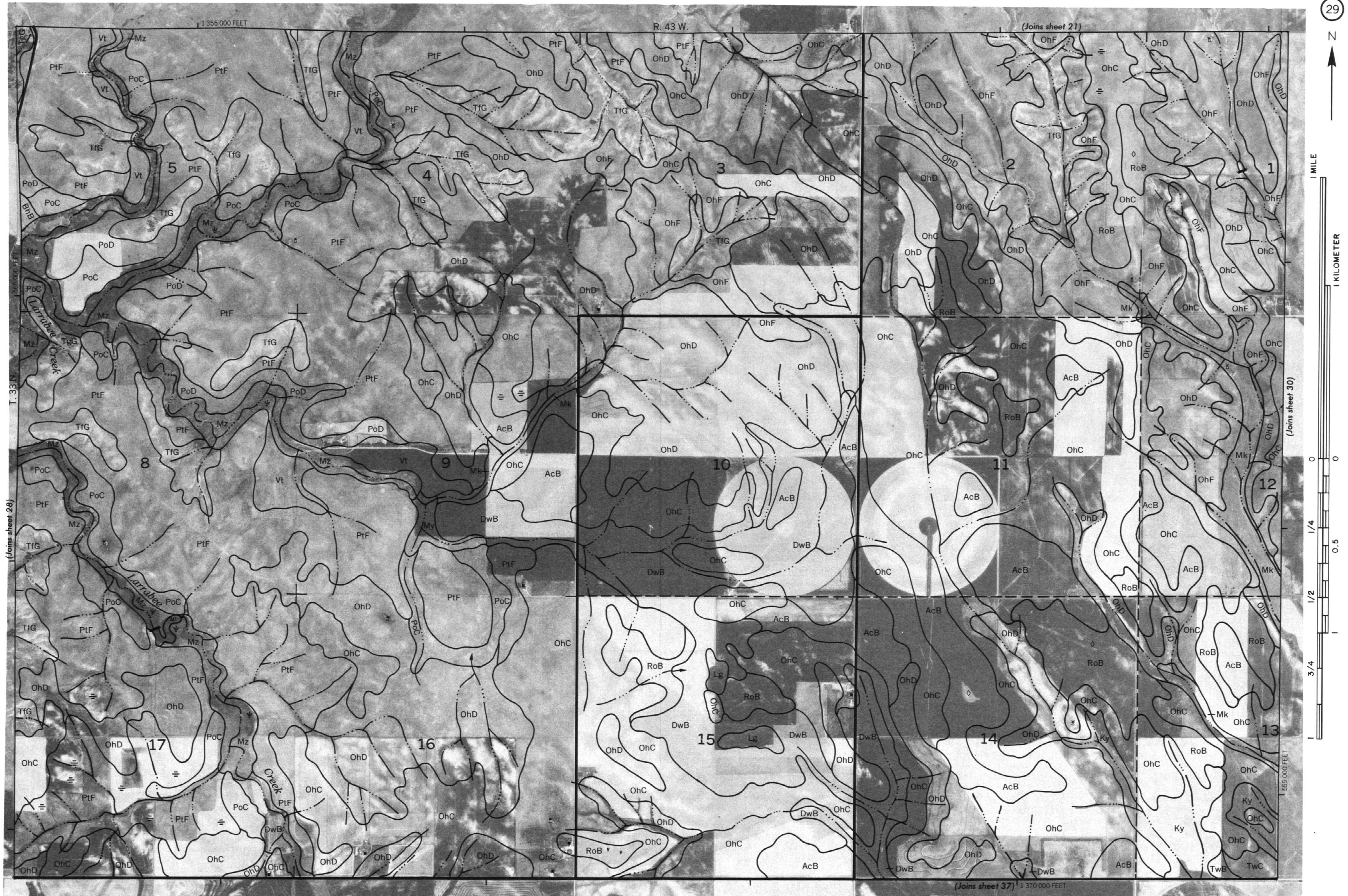


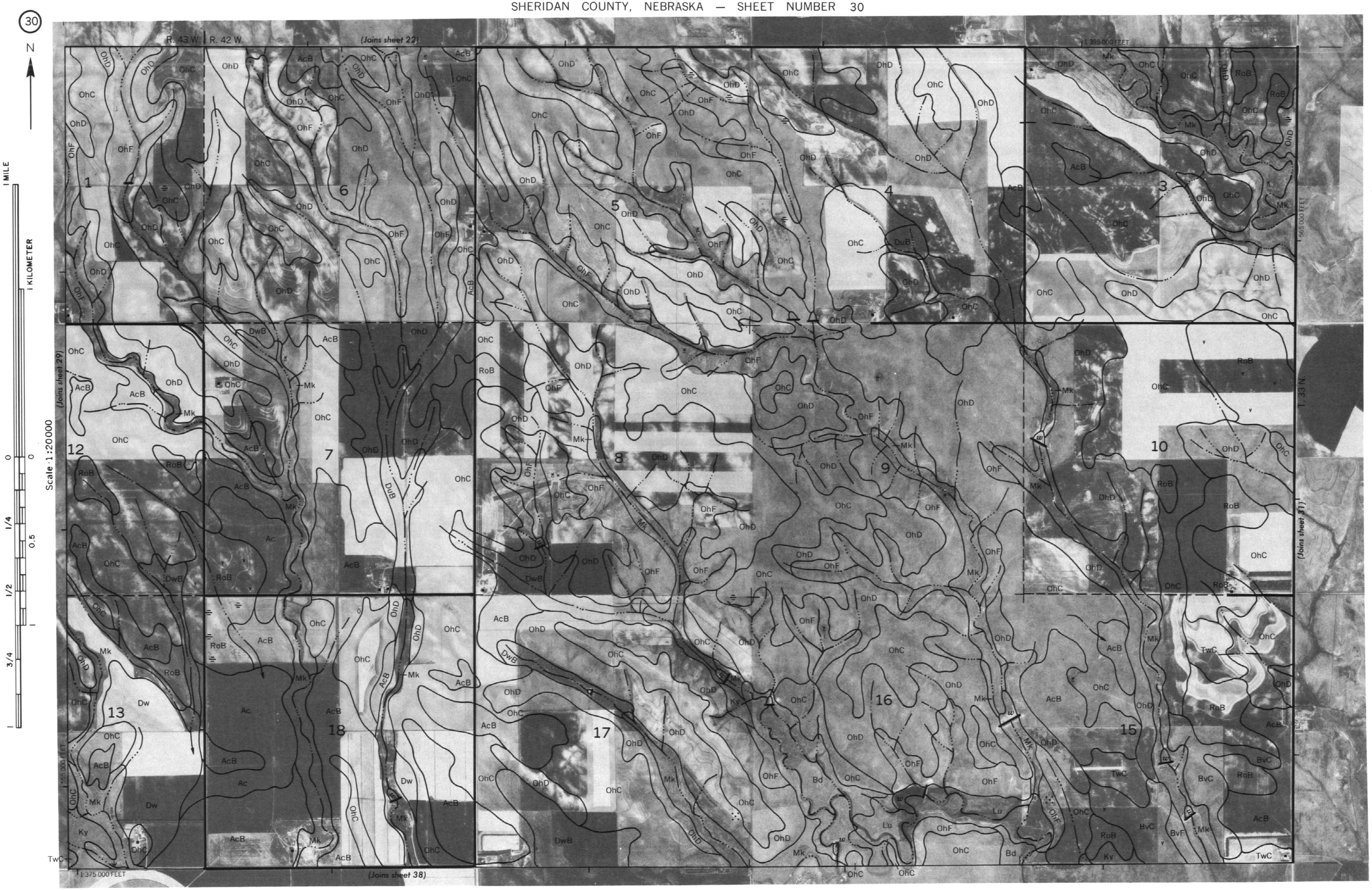
SHERIDAN COUNTY, NEBRASKA NO. 28

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

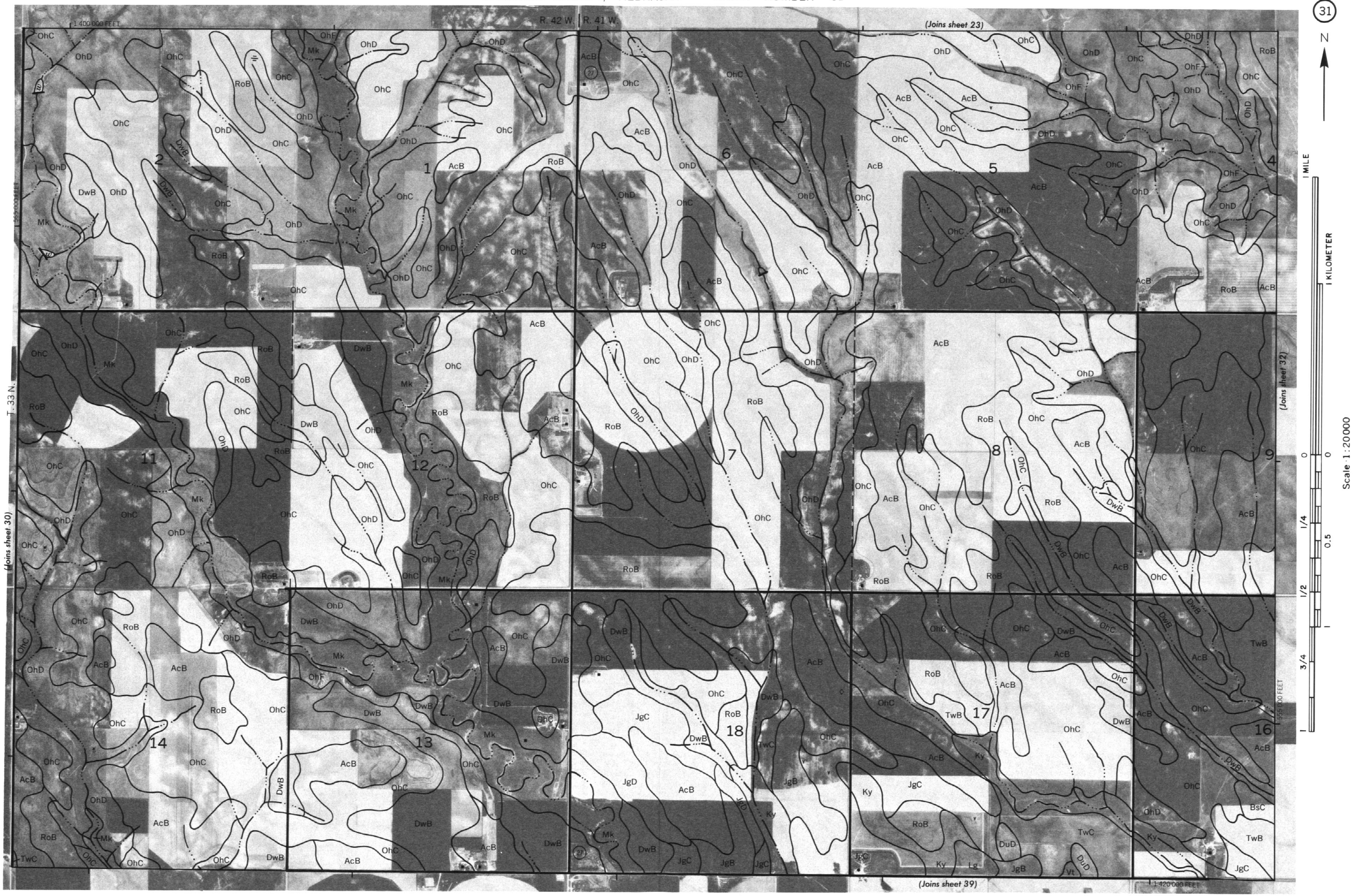
SHERIDAN COUNTY, NEBRASKA NO. 29





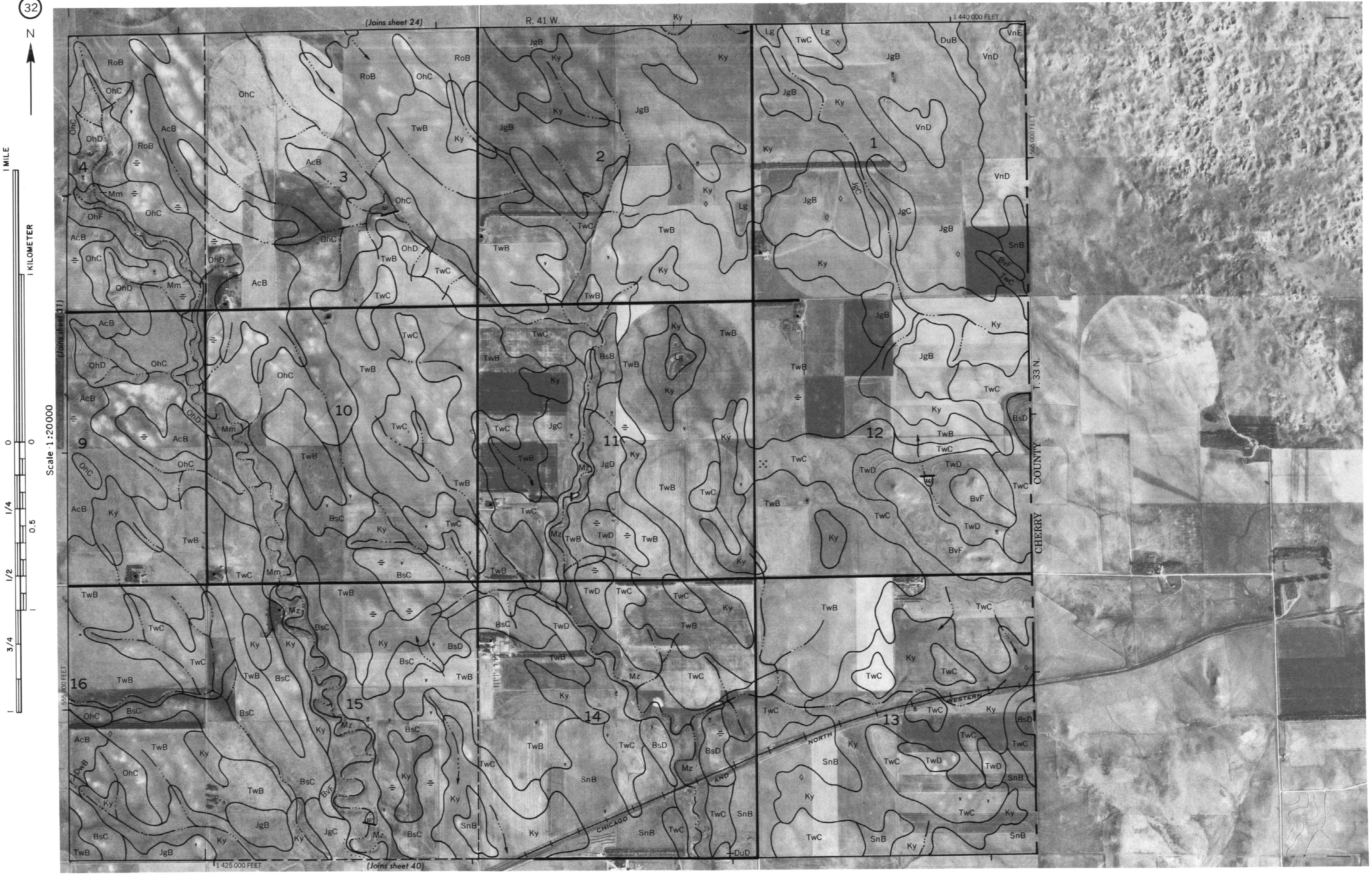
SHERIDAN COUNTY, NEBRASKA NO. 30

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



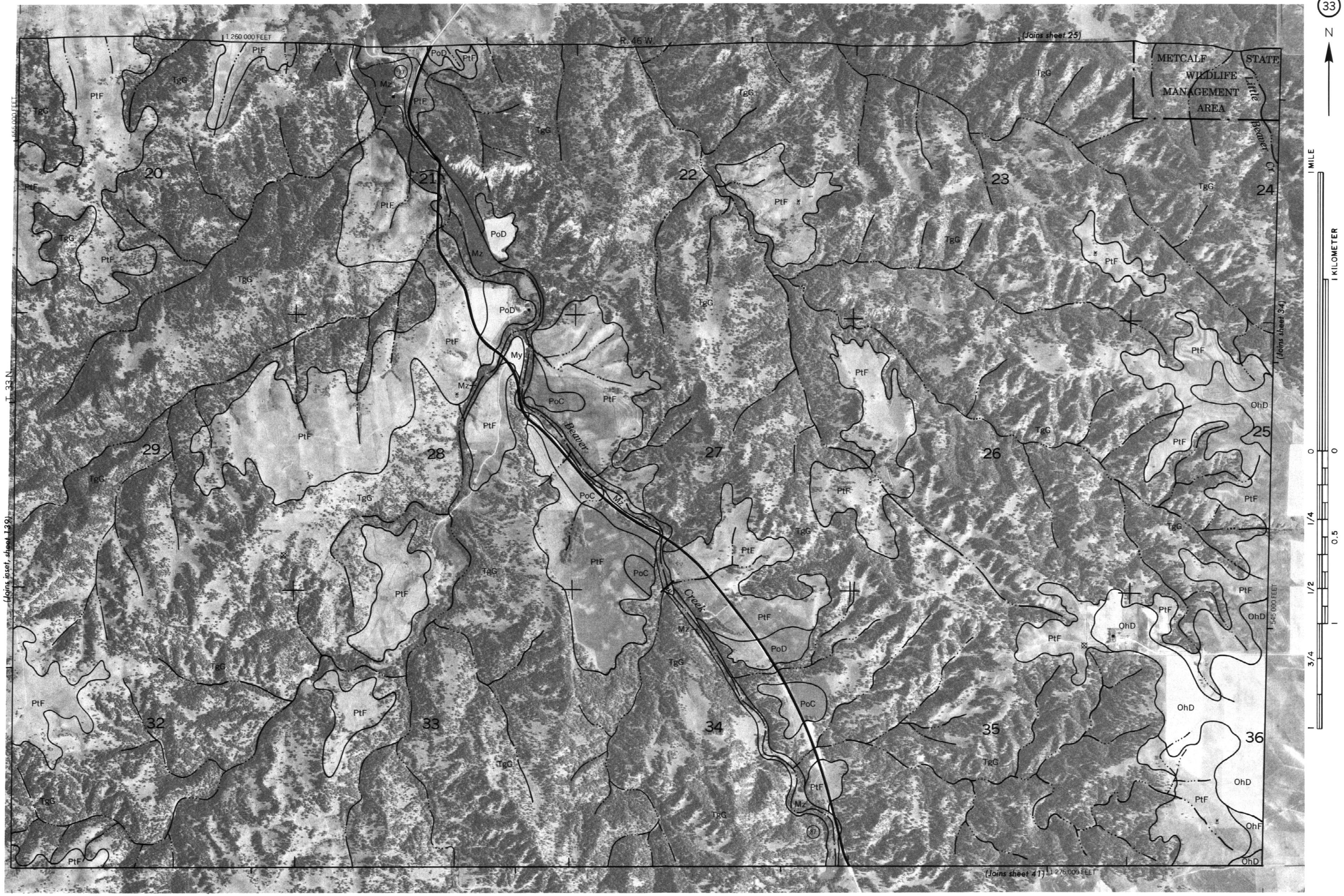
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 31



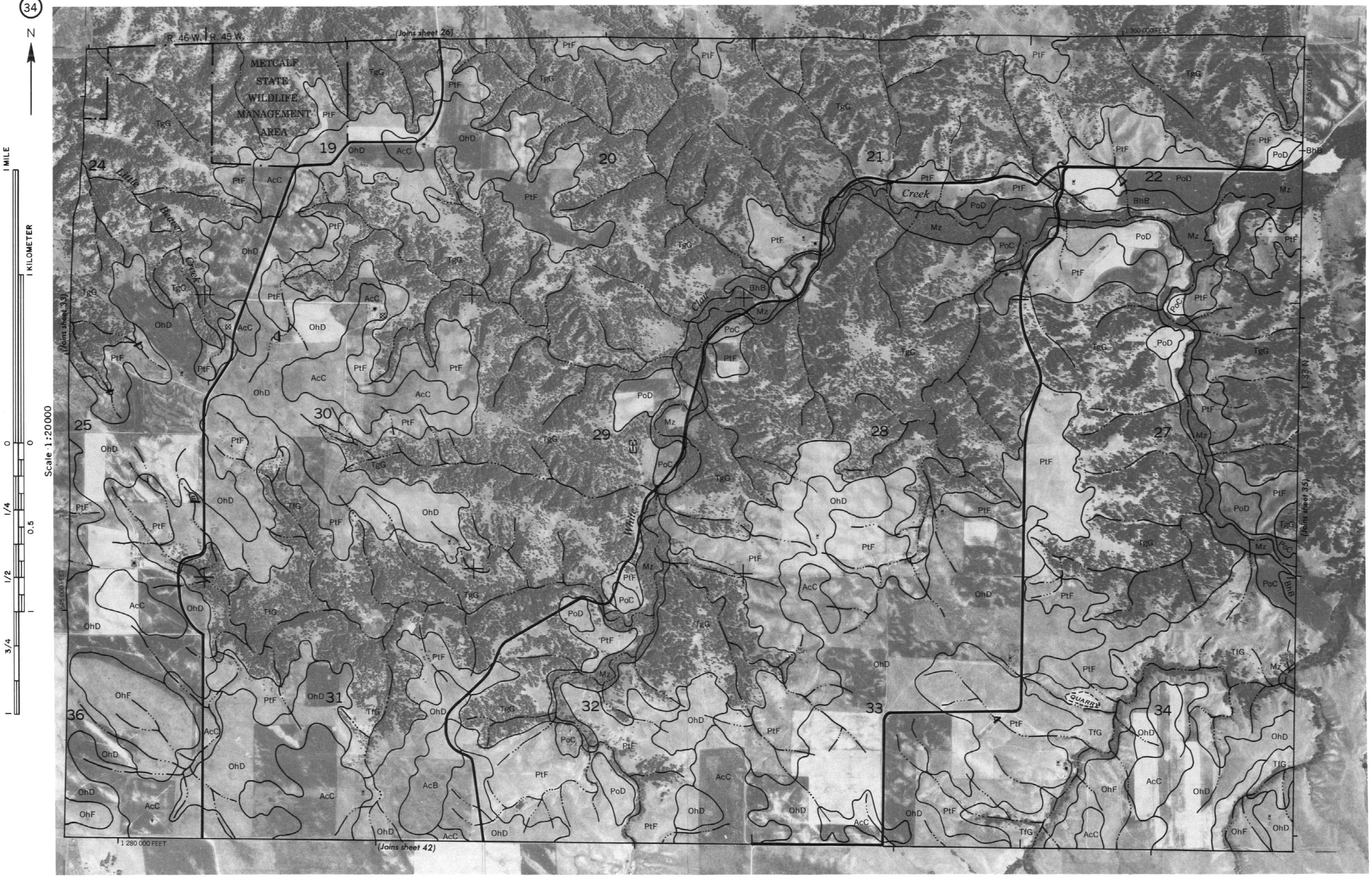
SHERIDAN COUNTY, NEBRASKA NO. 32

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



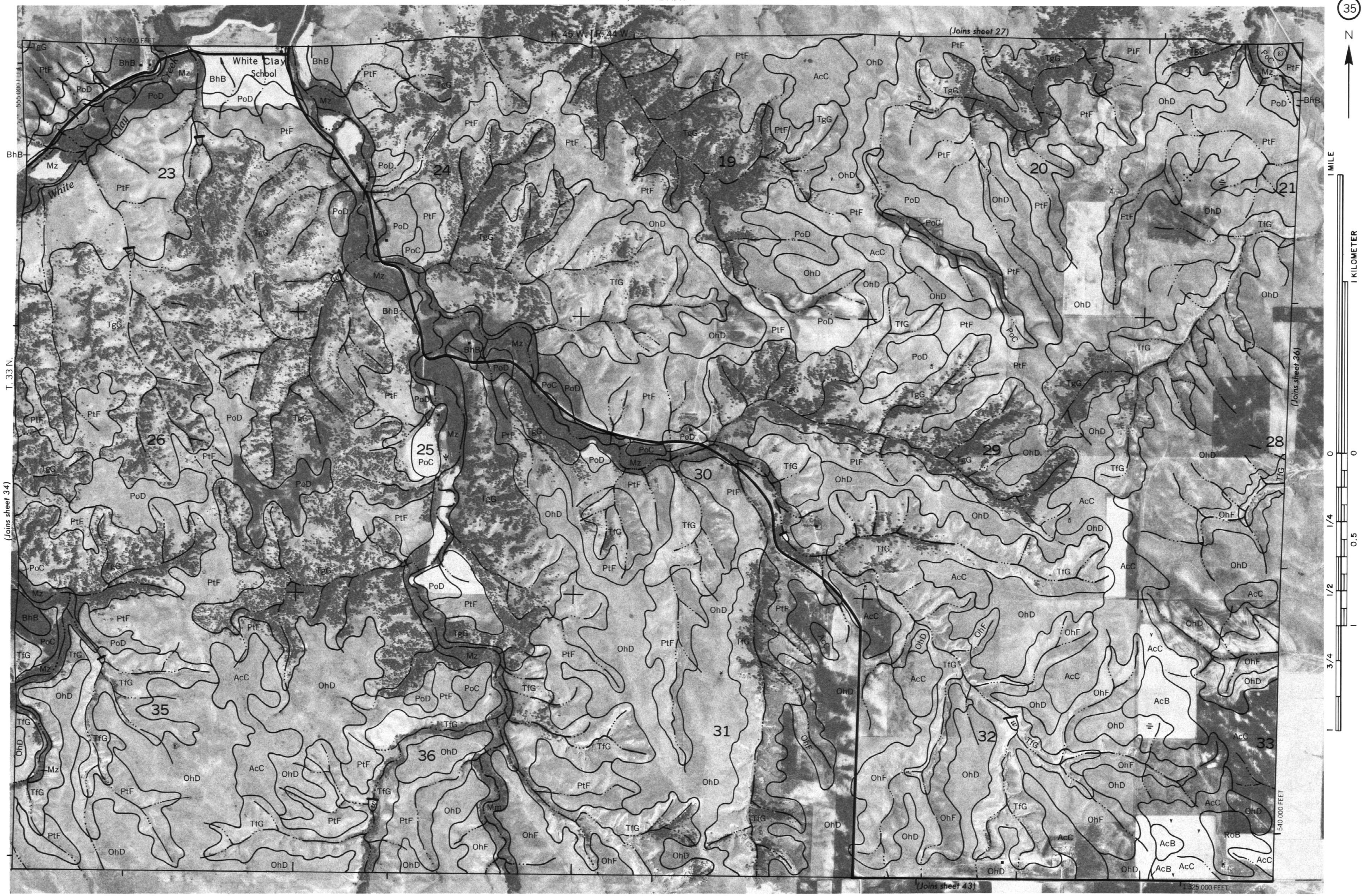
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 33

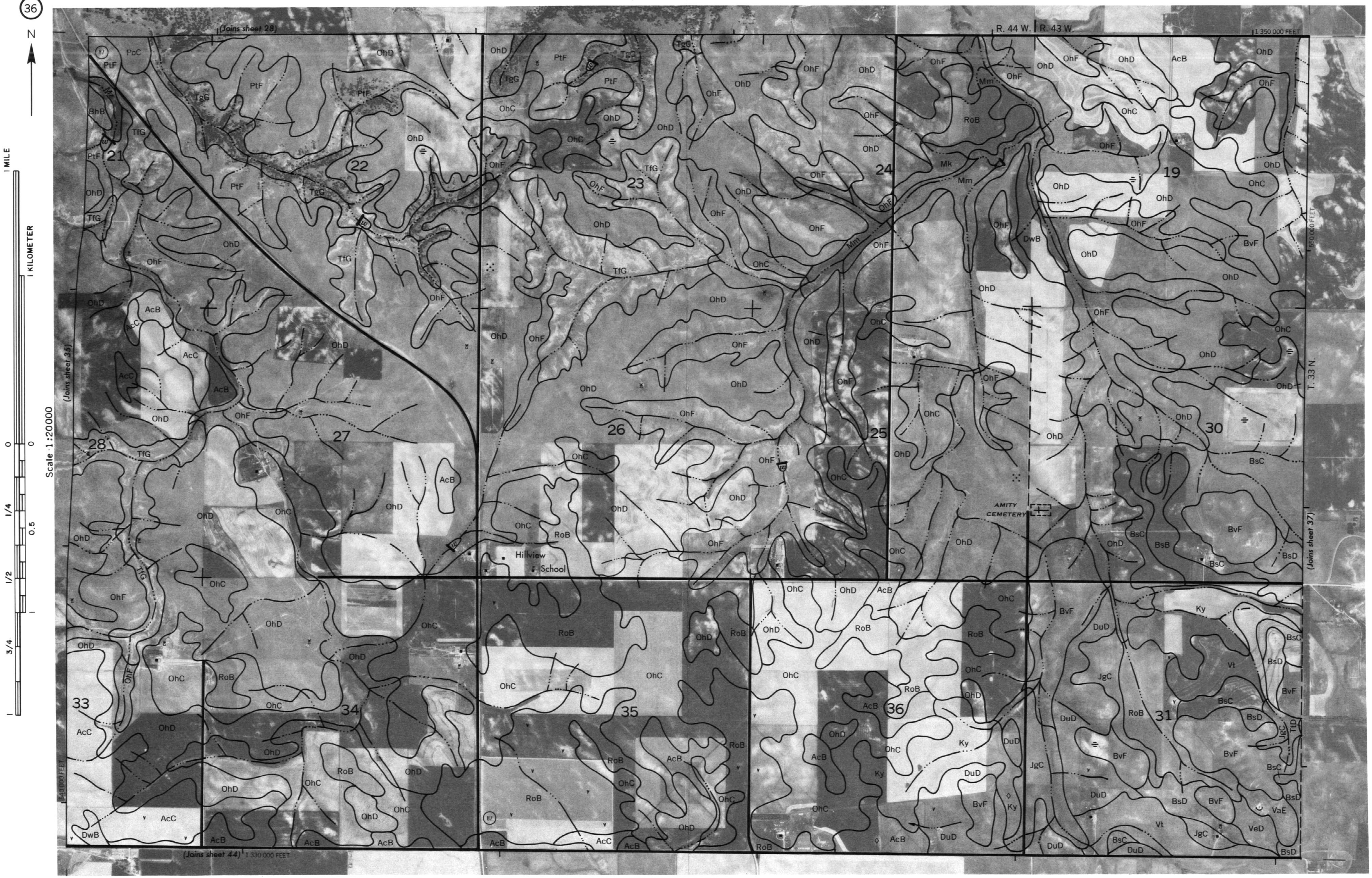


SHERIDAN COUNTY, NEBRASKA NO. 34

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

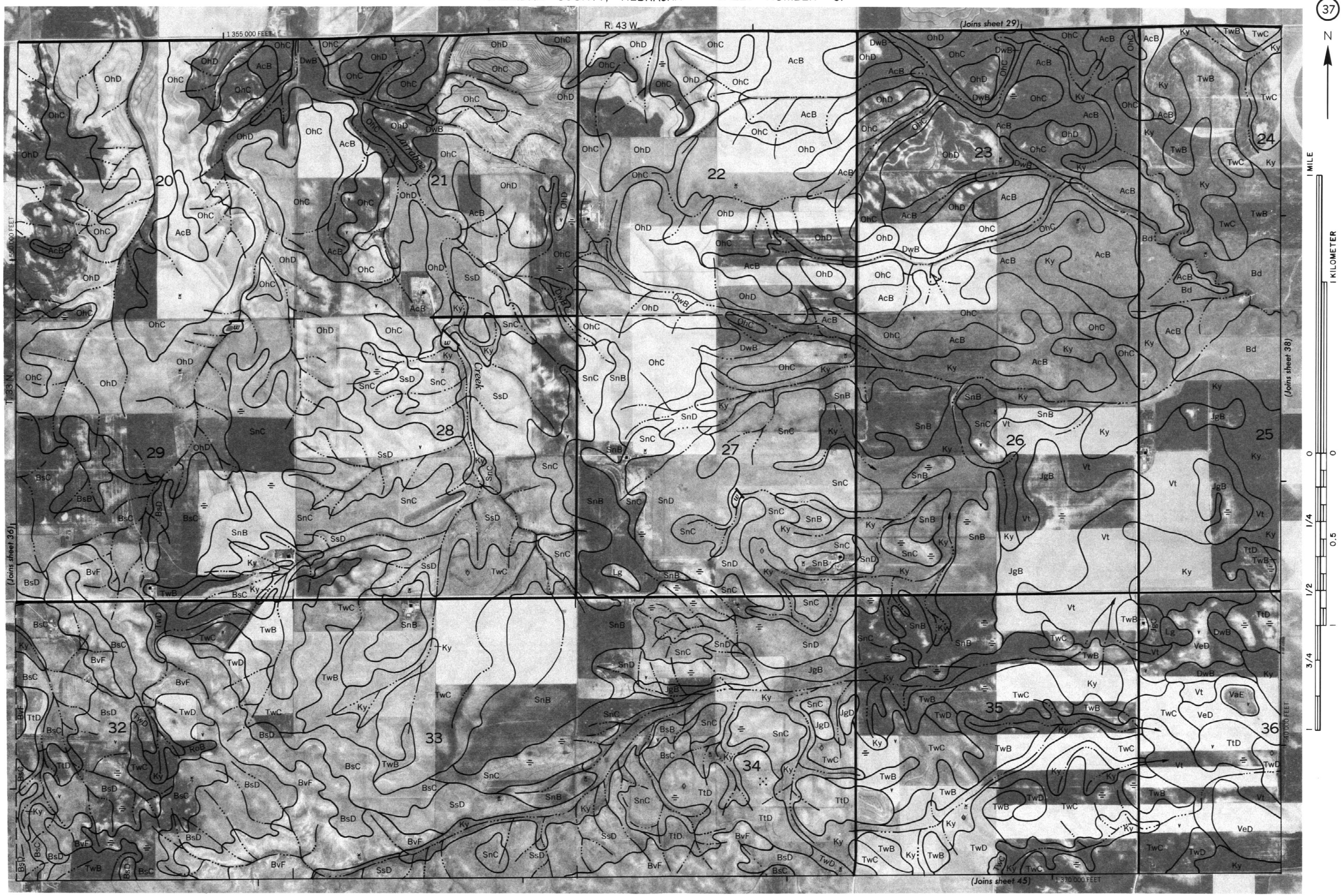


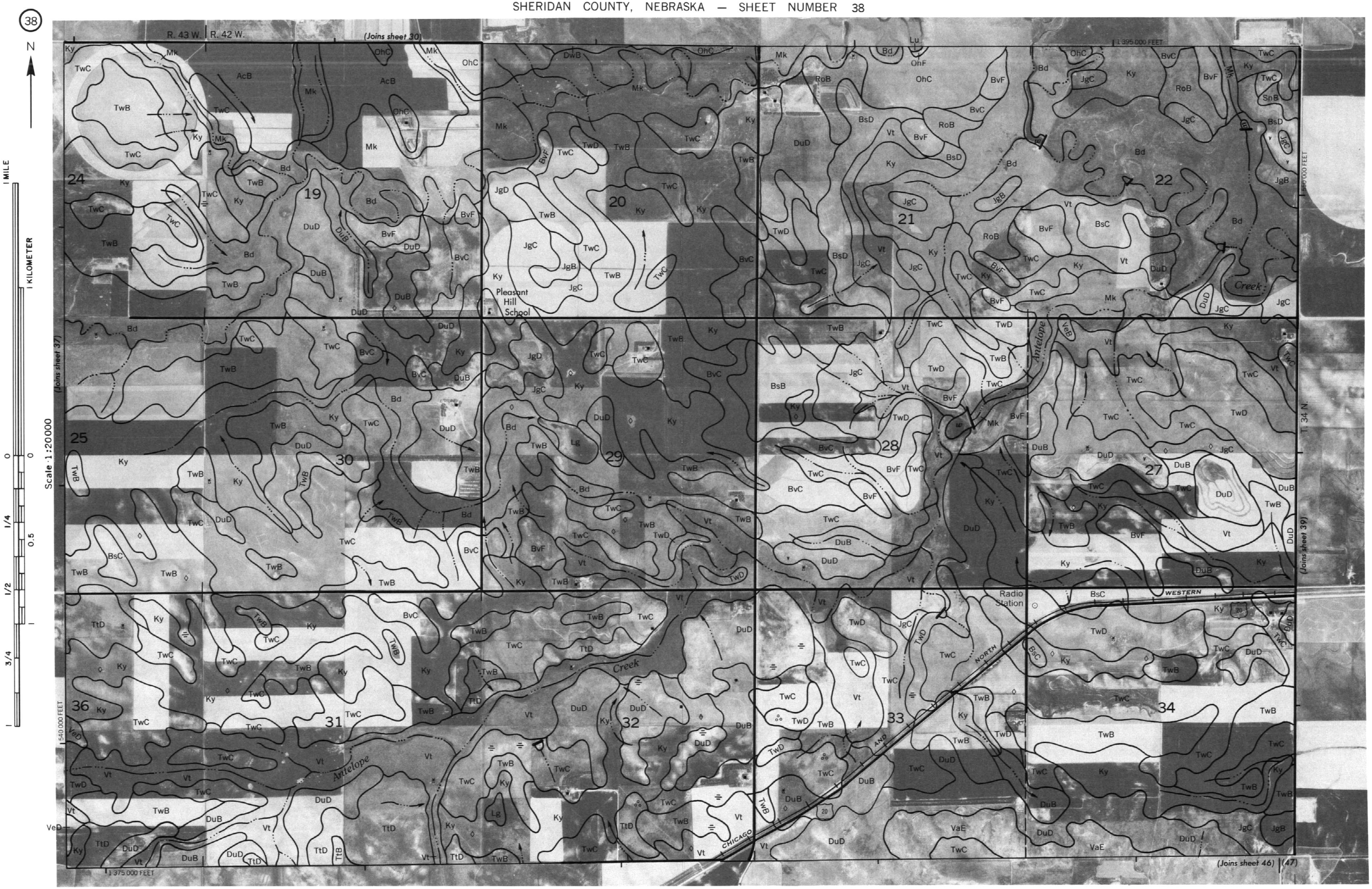
SHERIDAN COUNTY, NEBRASKA NO. 36

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

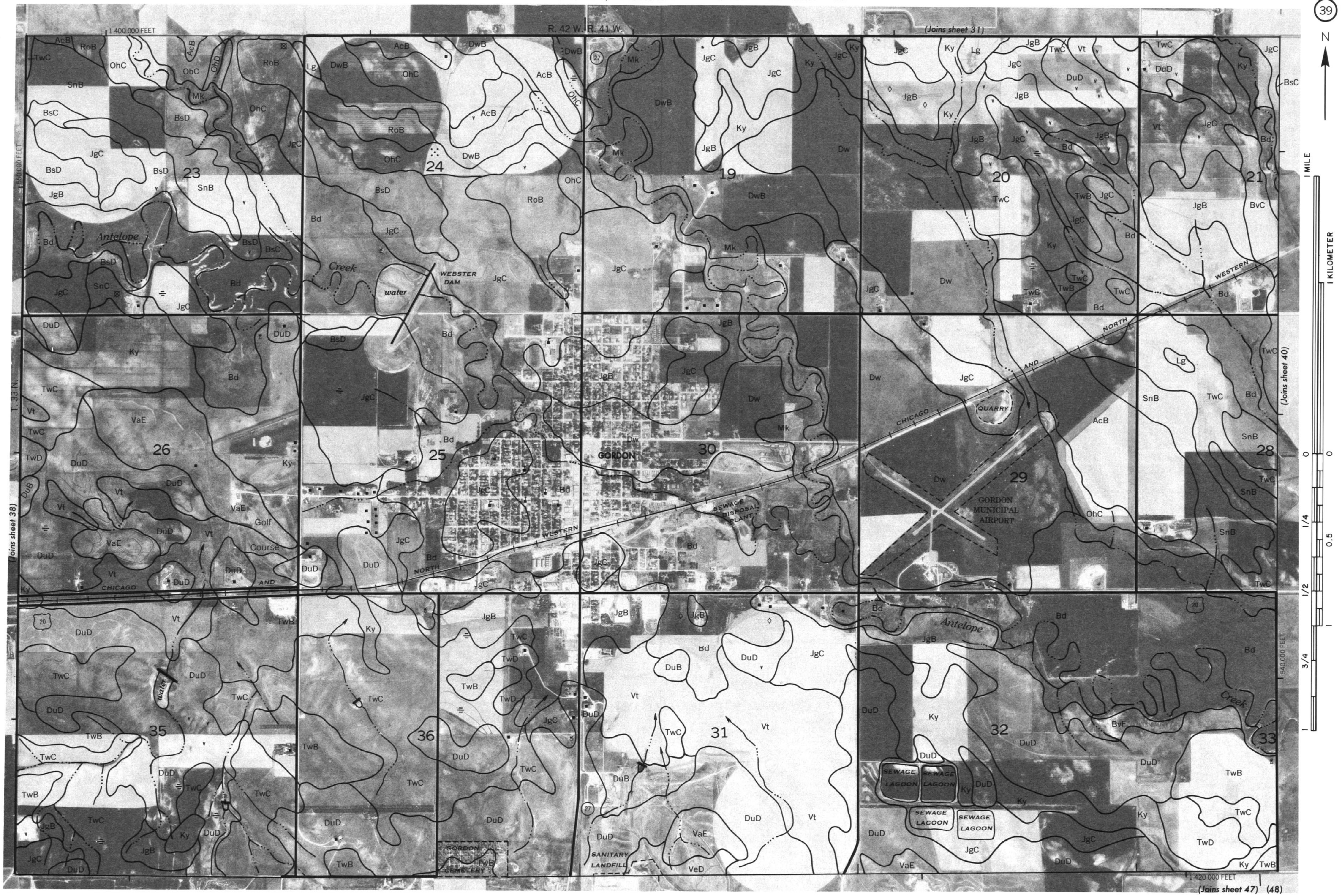
SHERIDAN COUNTY, NEBRASKA NO. 37





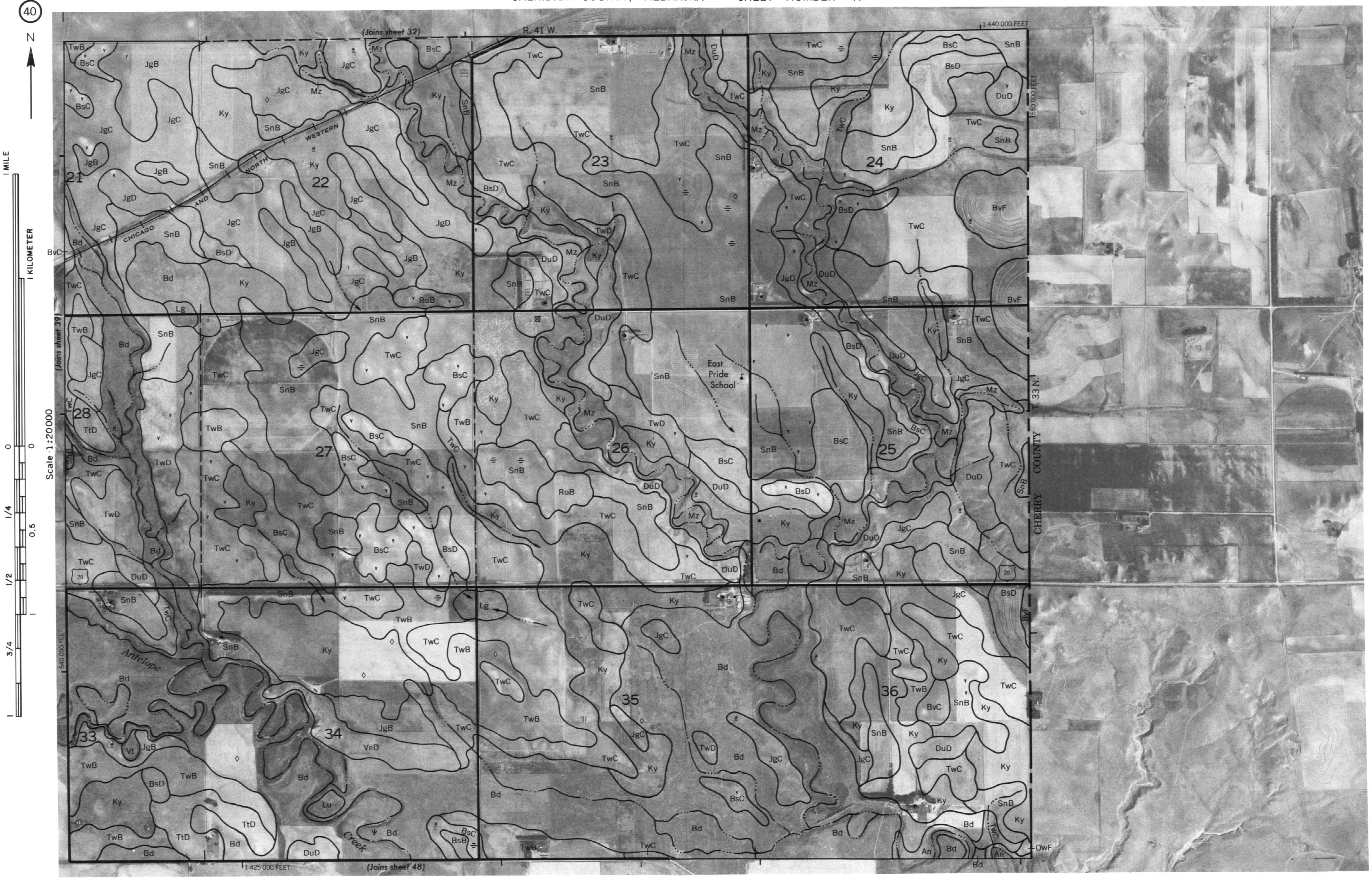
SHERIDAN COUNTY, NEBRASKA NO. 38

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned



SHERIDAN COUNTY, NEBRASKA NO. 39

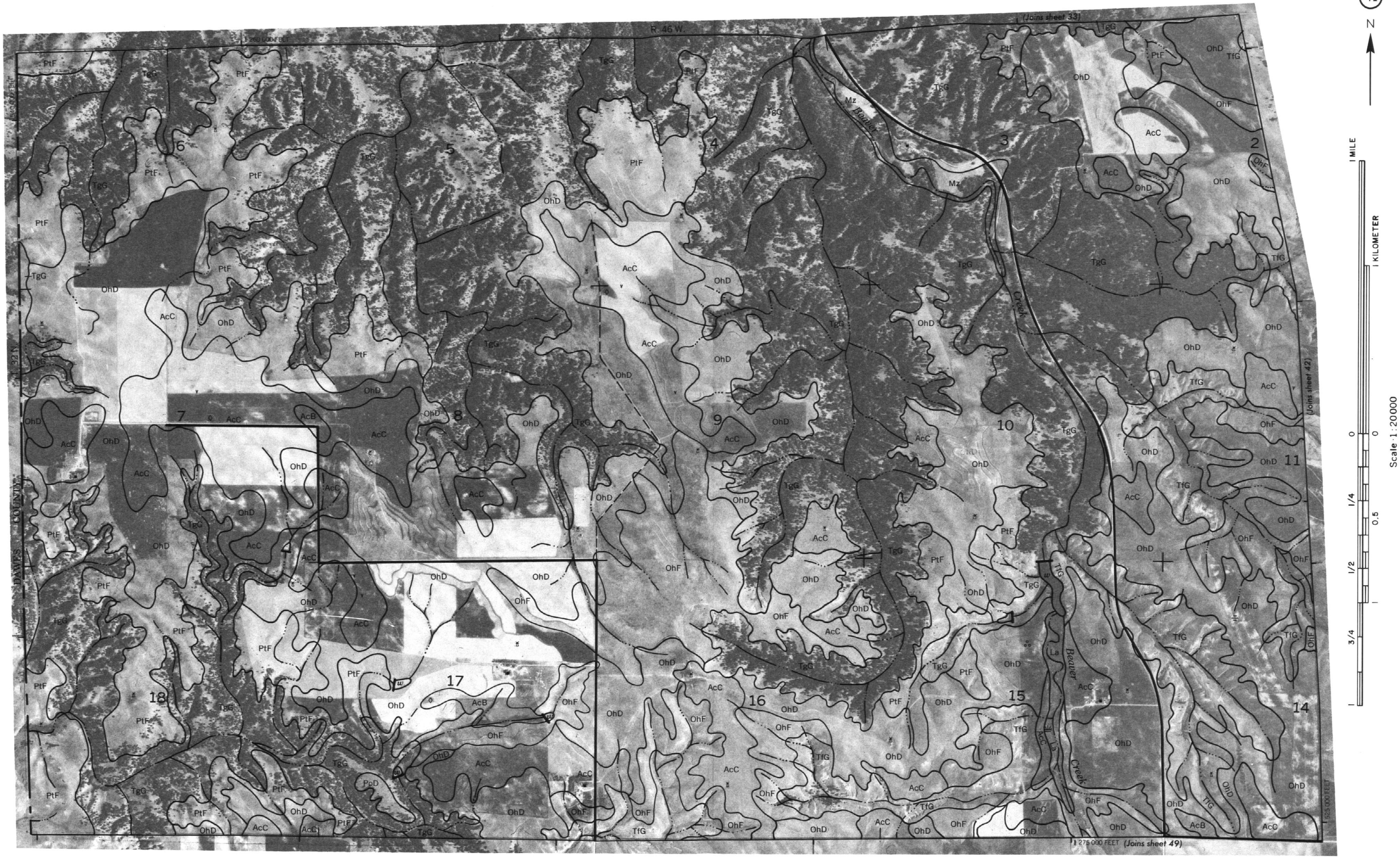
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



SHERIDAN COUNTY, NEBRASKA NO. 40

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

41



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

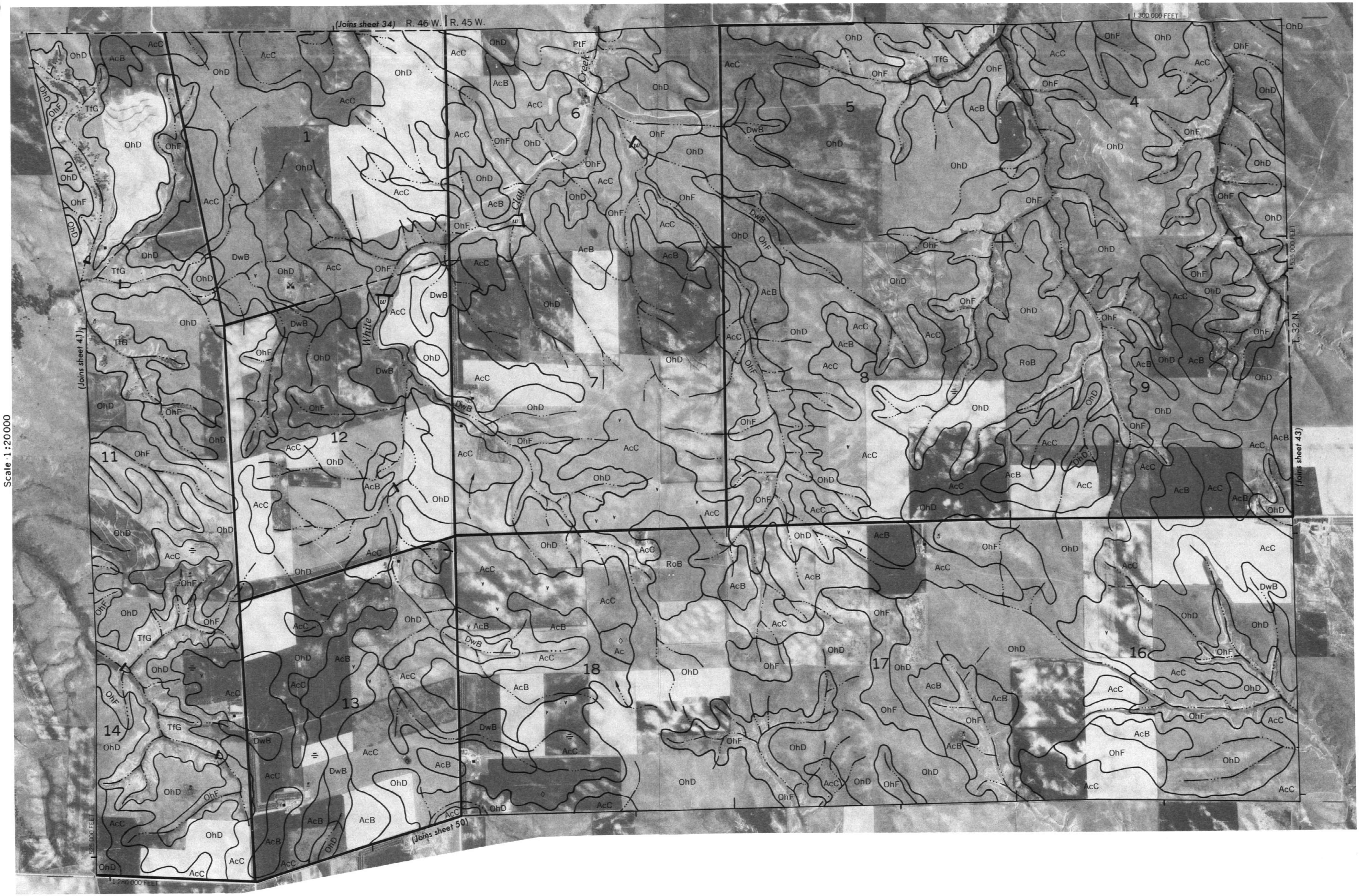
(42)

N

Scale 1:20000

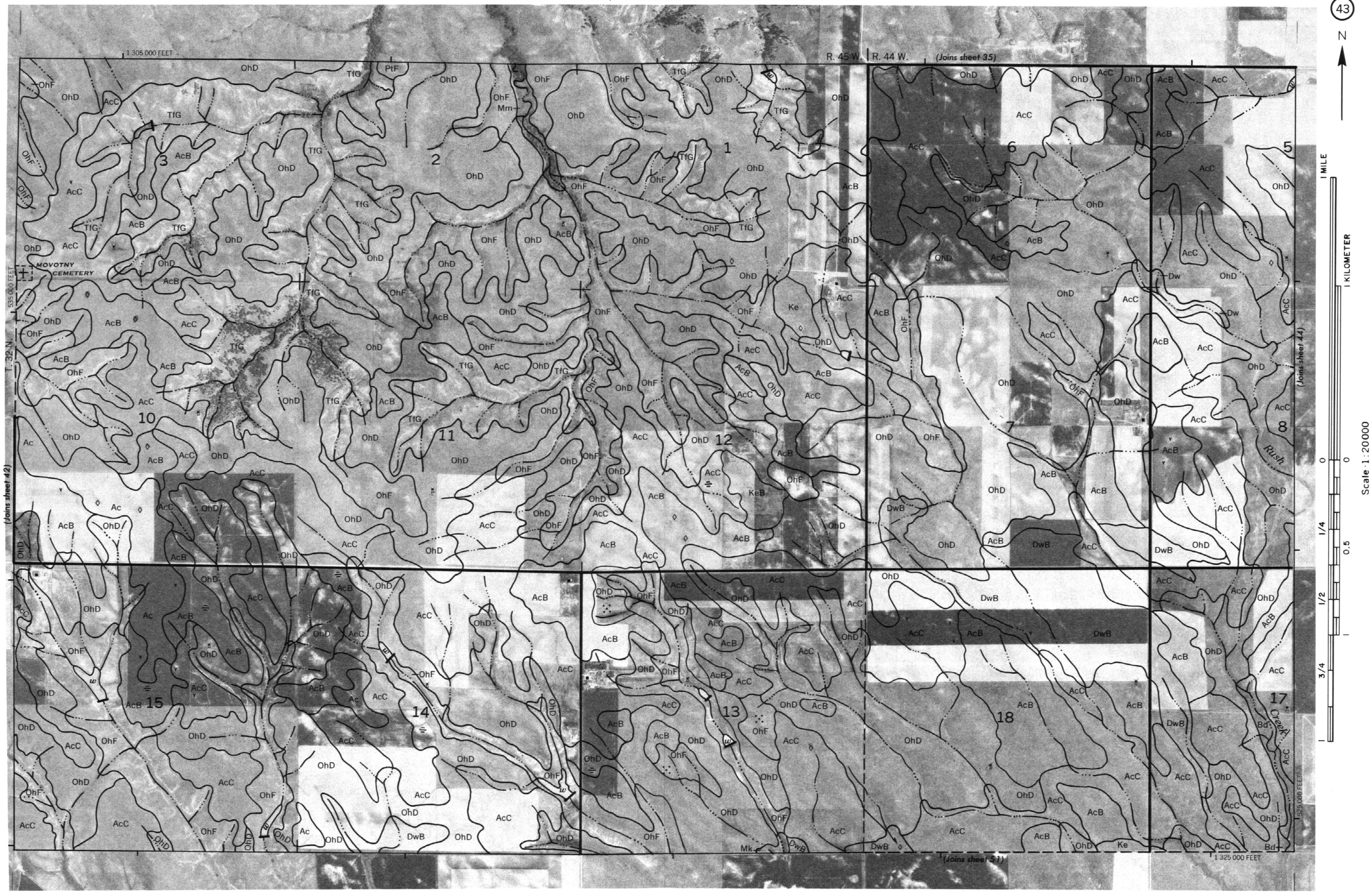
1 MILE
0 1/4 1/2 3/4 1

1 KILOMETER
0 0.5 1



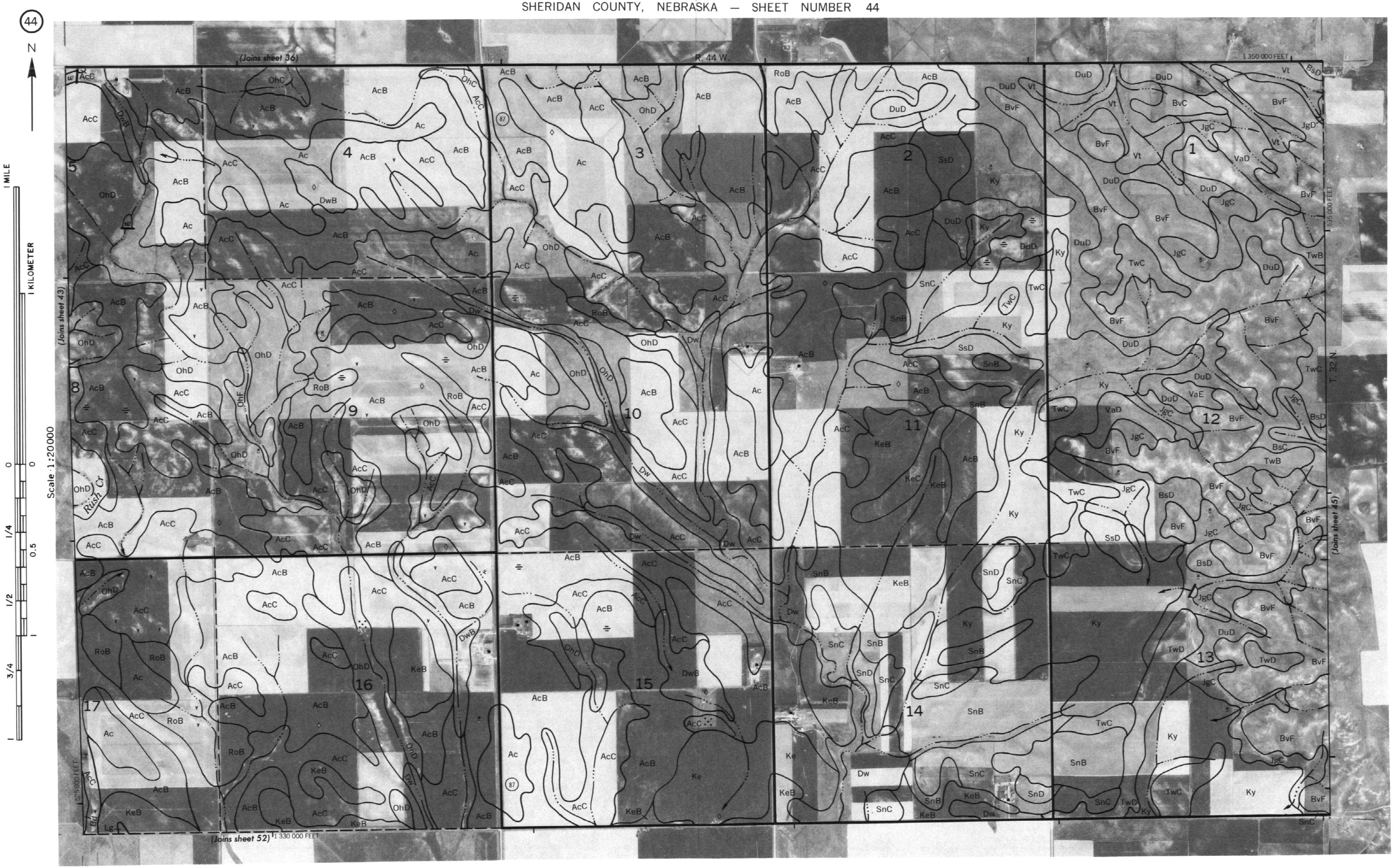
SHERIDAN COUNTY, NEBRASKA NO. 42

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



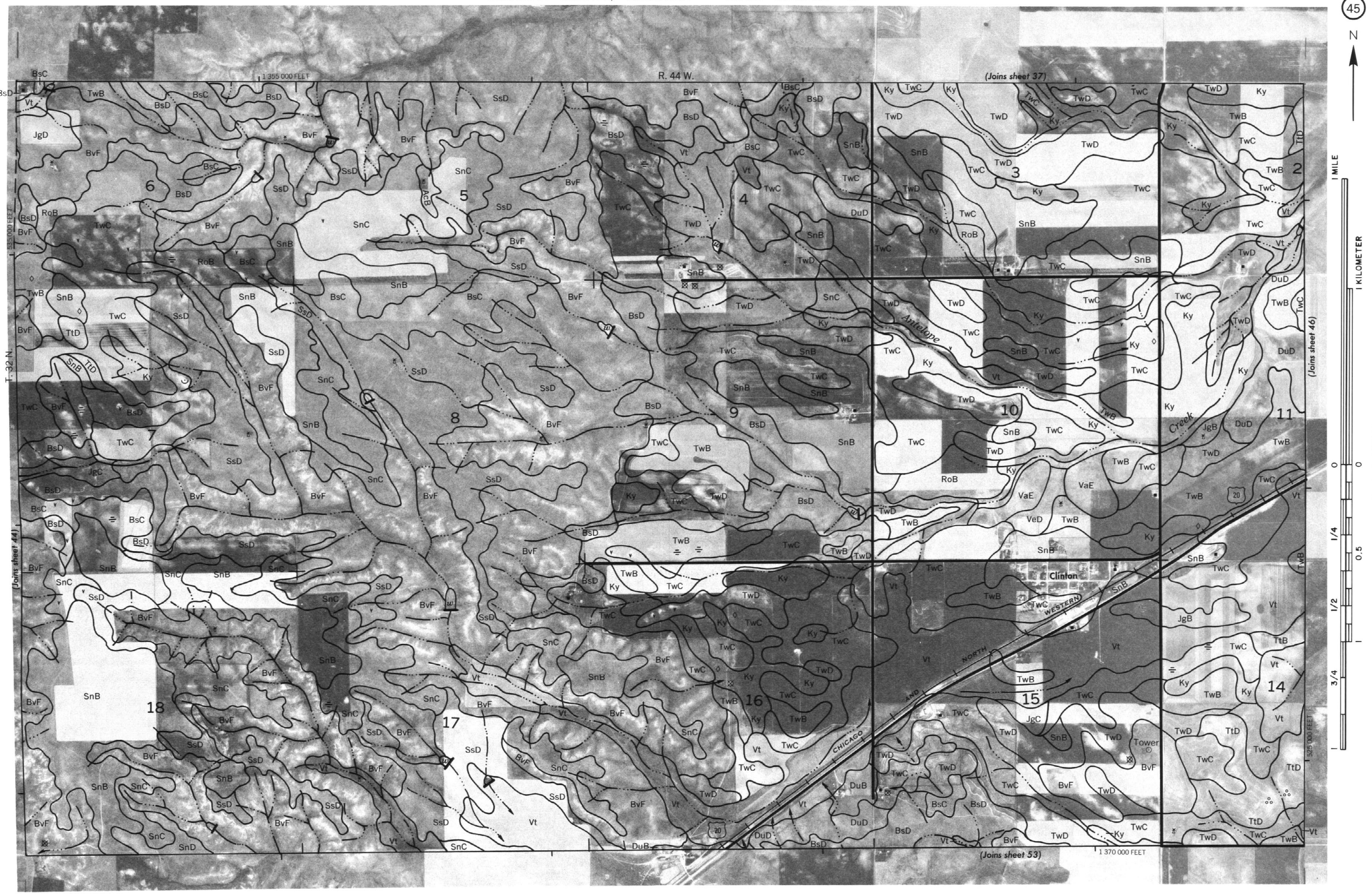
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 43



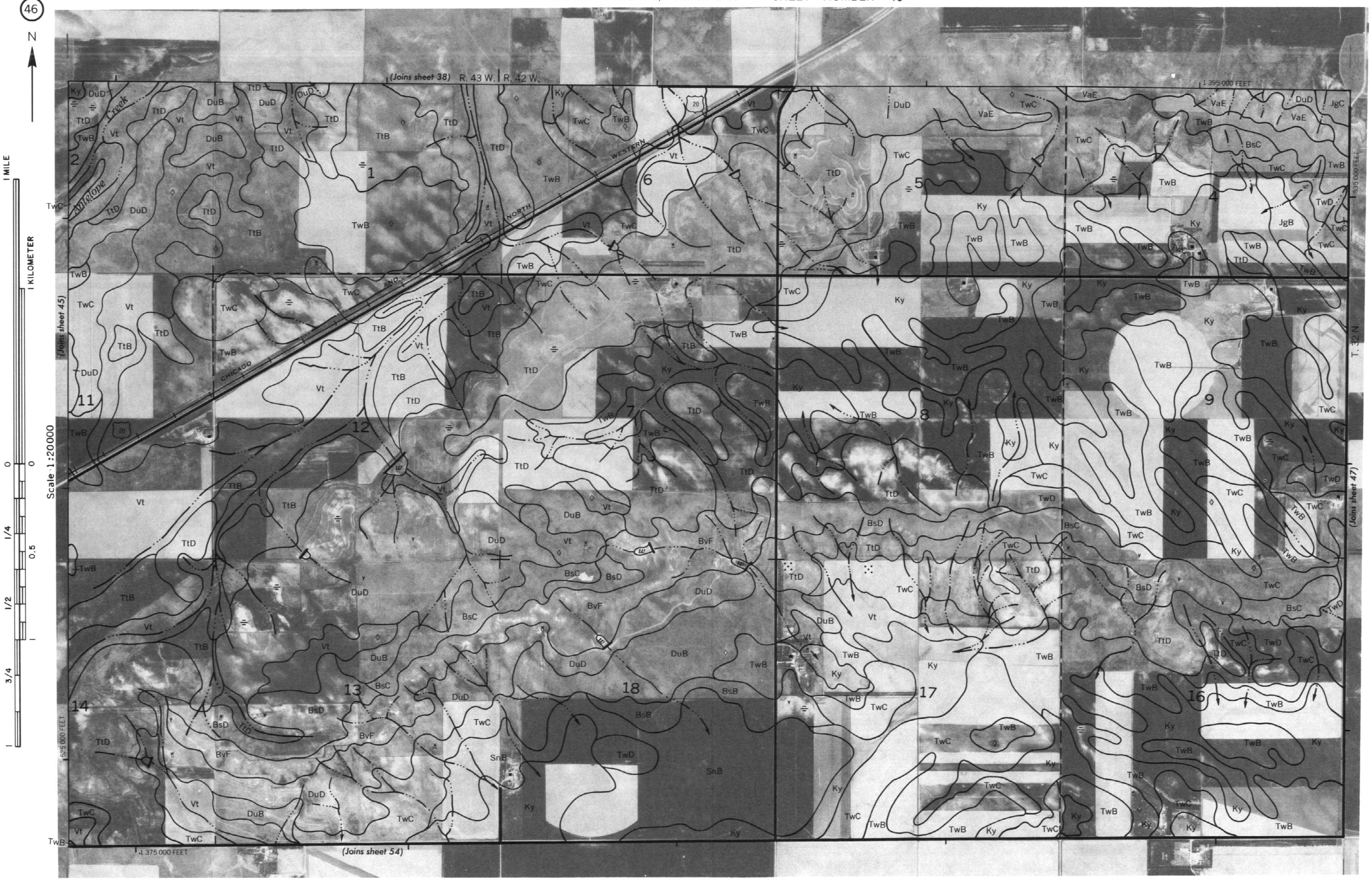
SHERIDAN COUNTY, NEBRASKA NO. 44

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 45

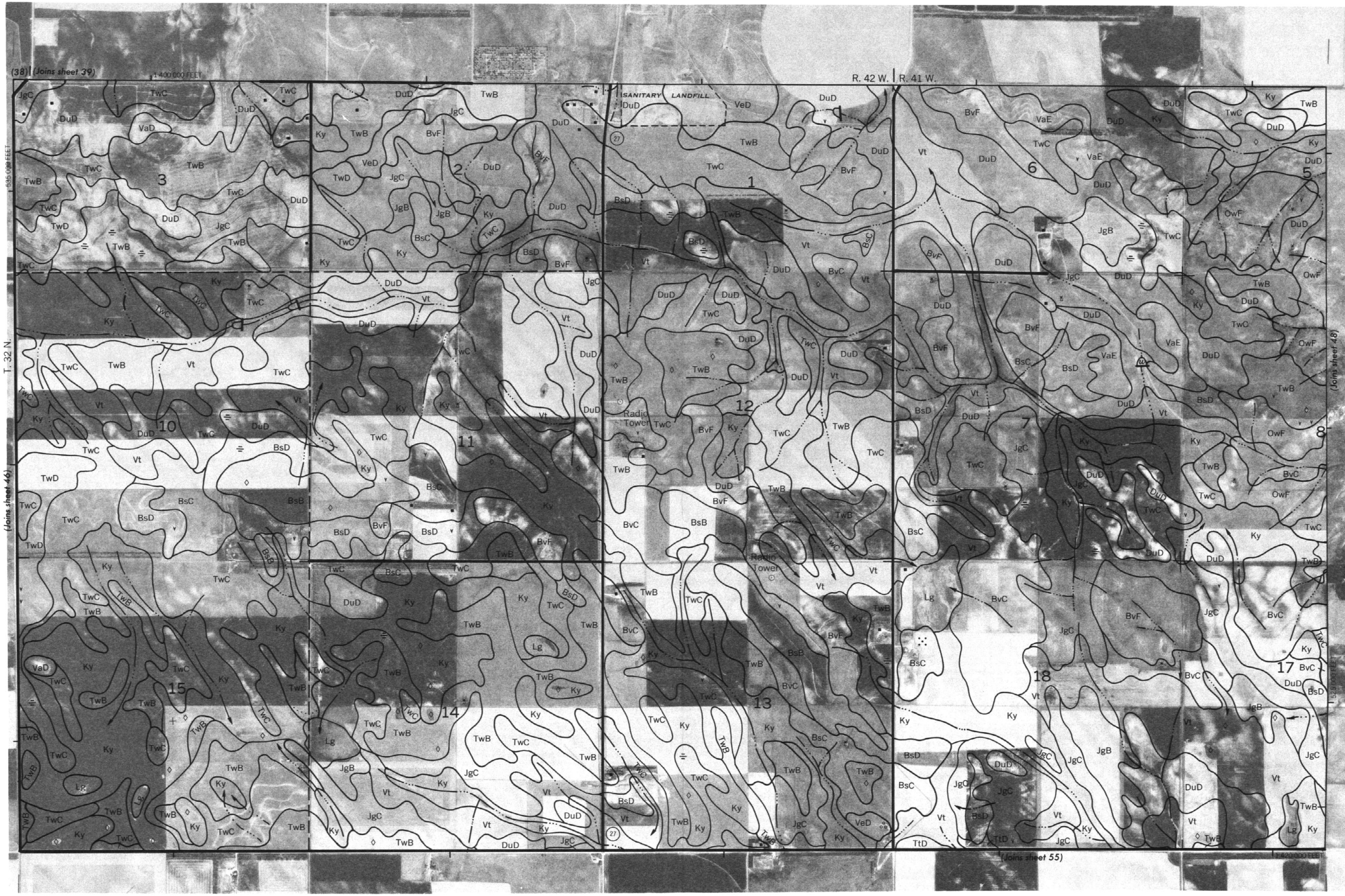


SHERIDAN COUNTY, NEBRASKA NO. 46

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

47

N



1 MILE

1 KILOMETER

0 1/4 1/2 3/4 1

0 0.5 1

Scale 1:20000

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 47

(48)

N

1 MILE

1 KILOMETER

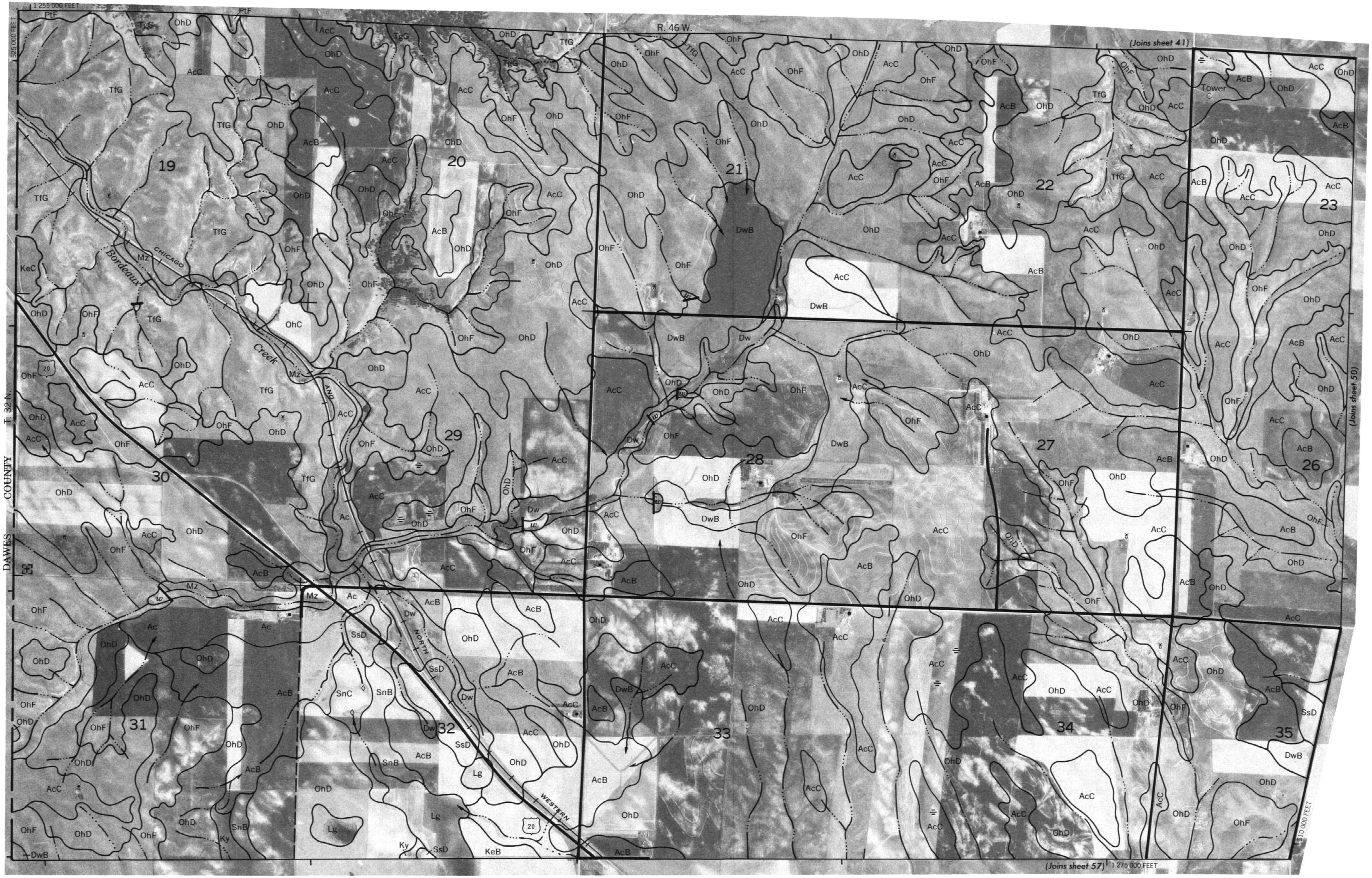
Scale 1:20000

0 1/4 1/2 3/4 1

0 0.5 1

SHERIDAN COUNTY, NEBRASKA NO. 48

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



N

1 MILE

1 KILOMETER

Scale 1:20000

0 1/4 1/2 3/4 1

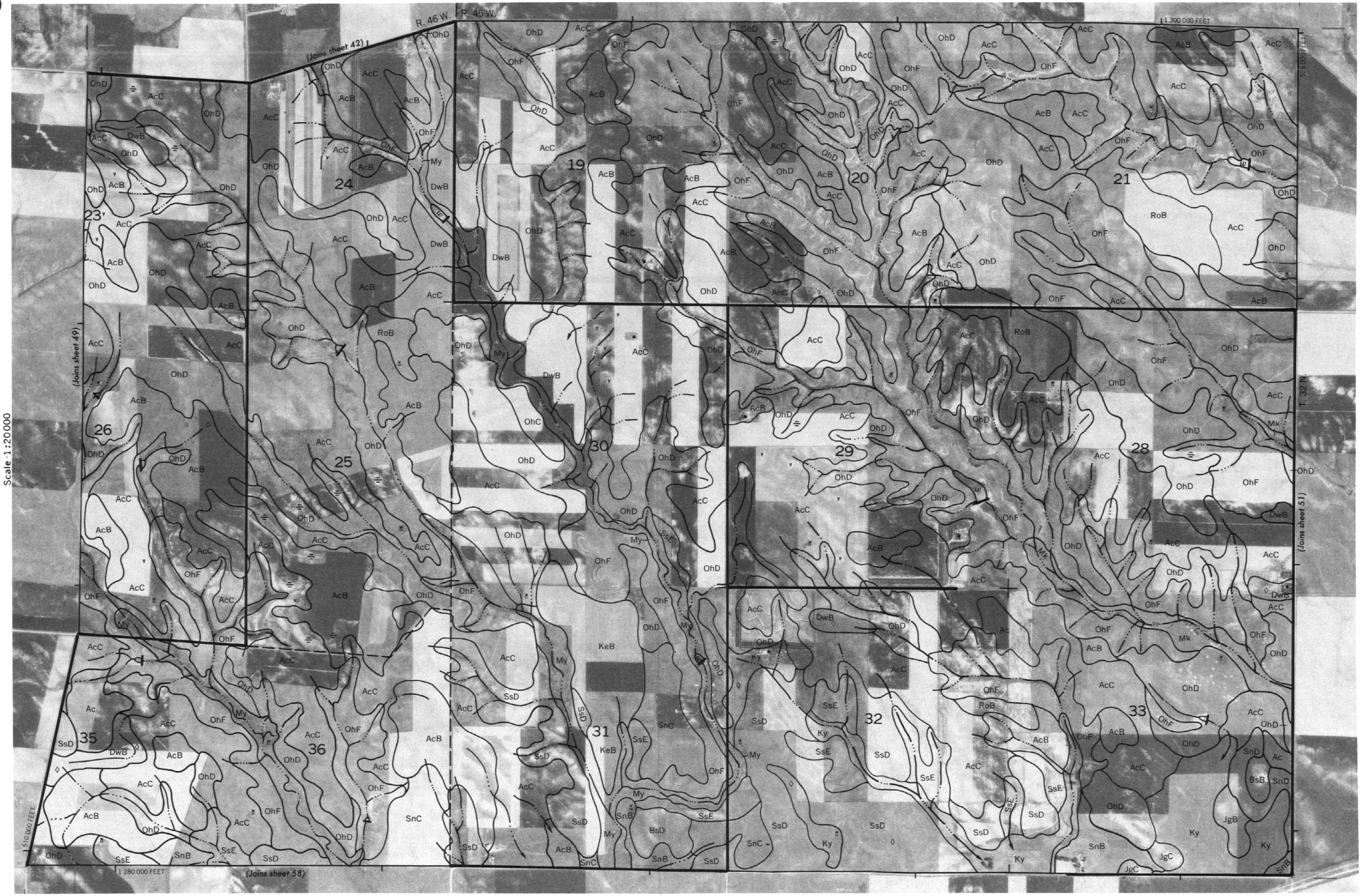
0 0.5 1

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA — SHEET NUMBER 50

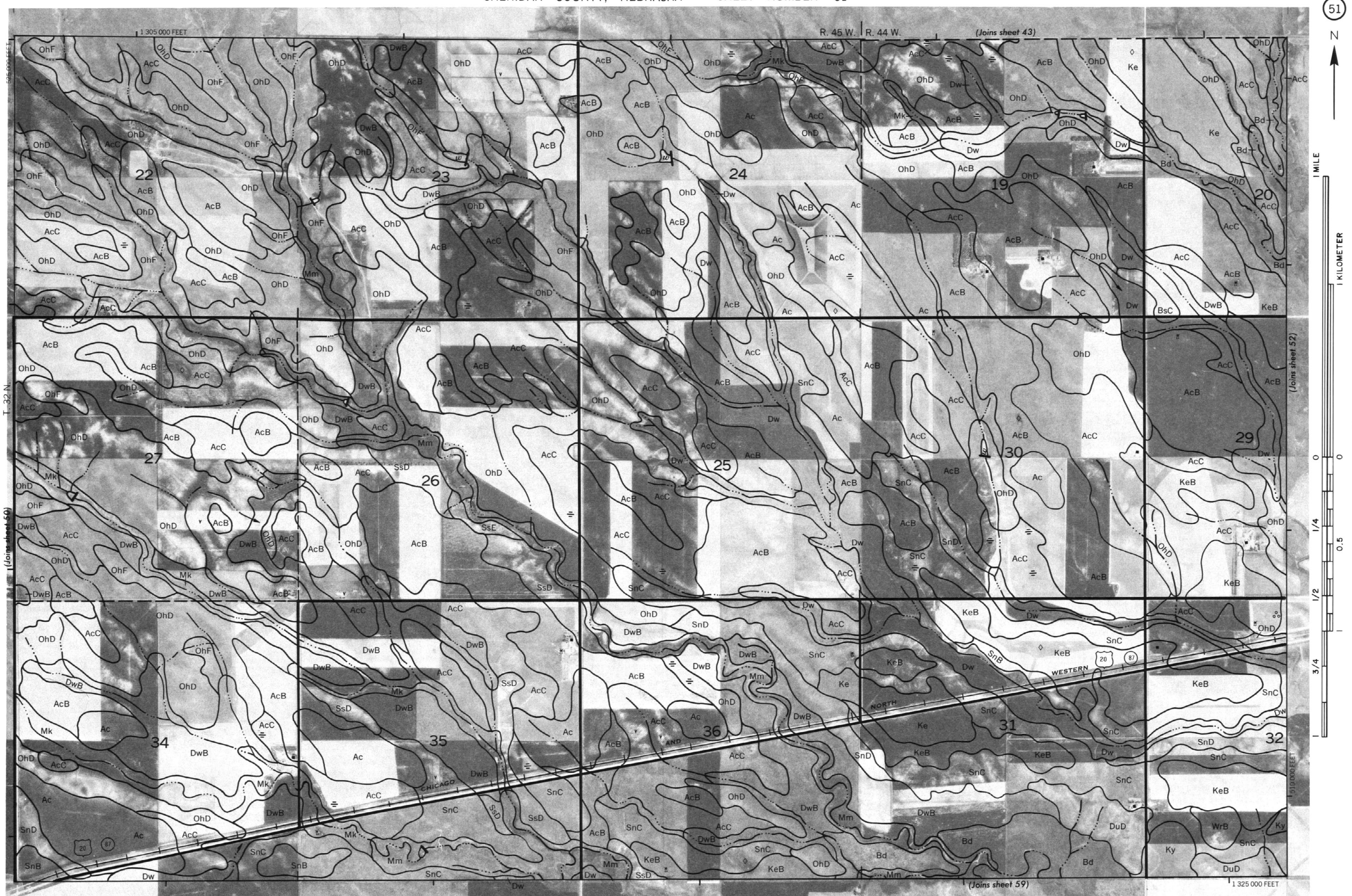
N

1 MILE
0 1/4 1/2 3/4 1
1 KILOMETER
0 0.5 1
Scale 1:20000



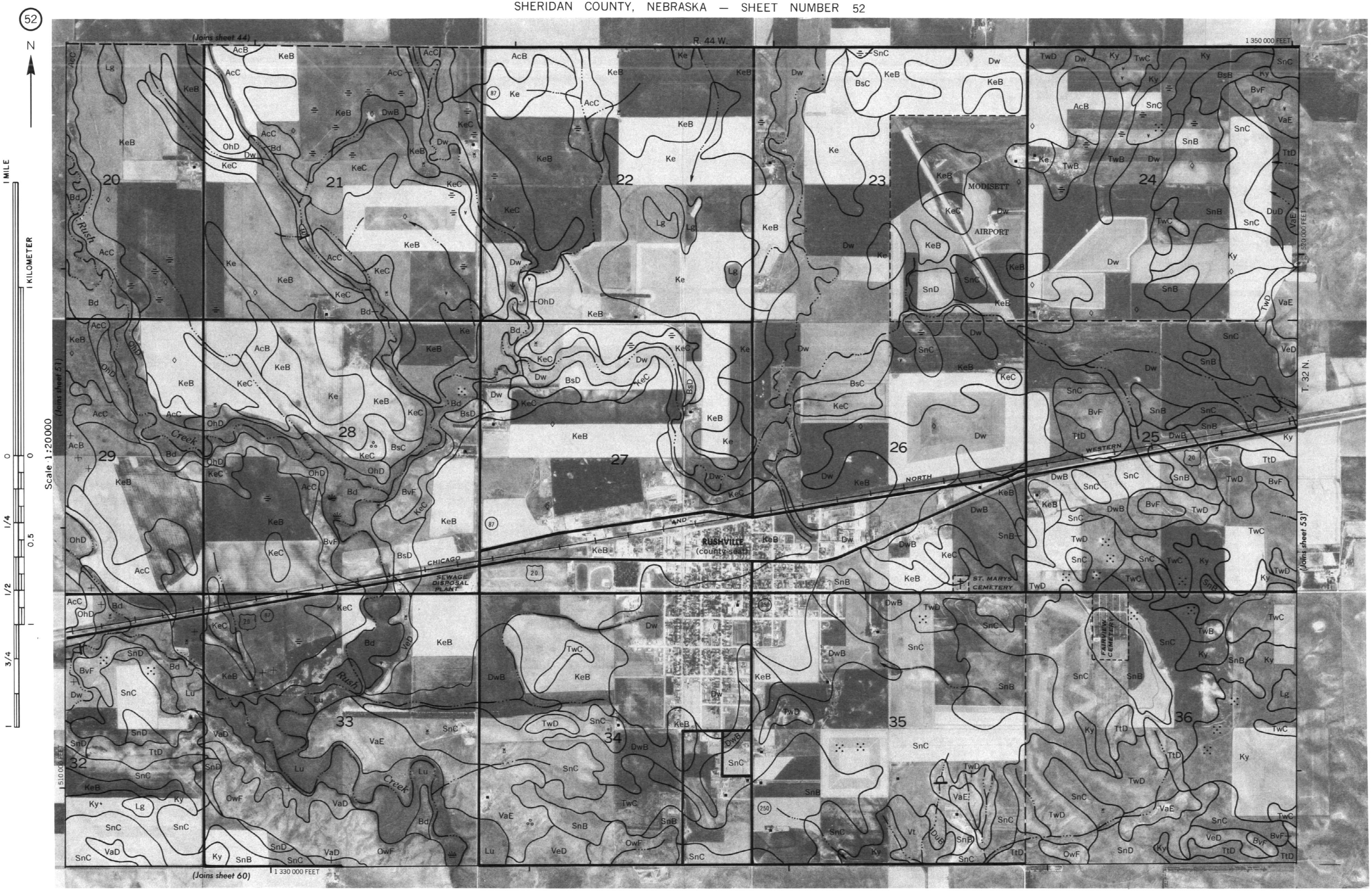
SHERIDAN COUNTY, NEBRASKA NO. 50

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 51

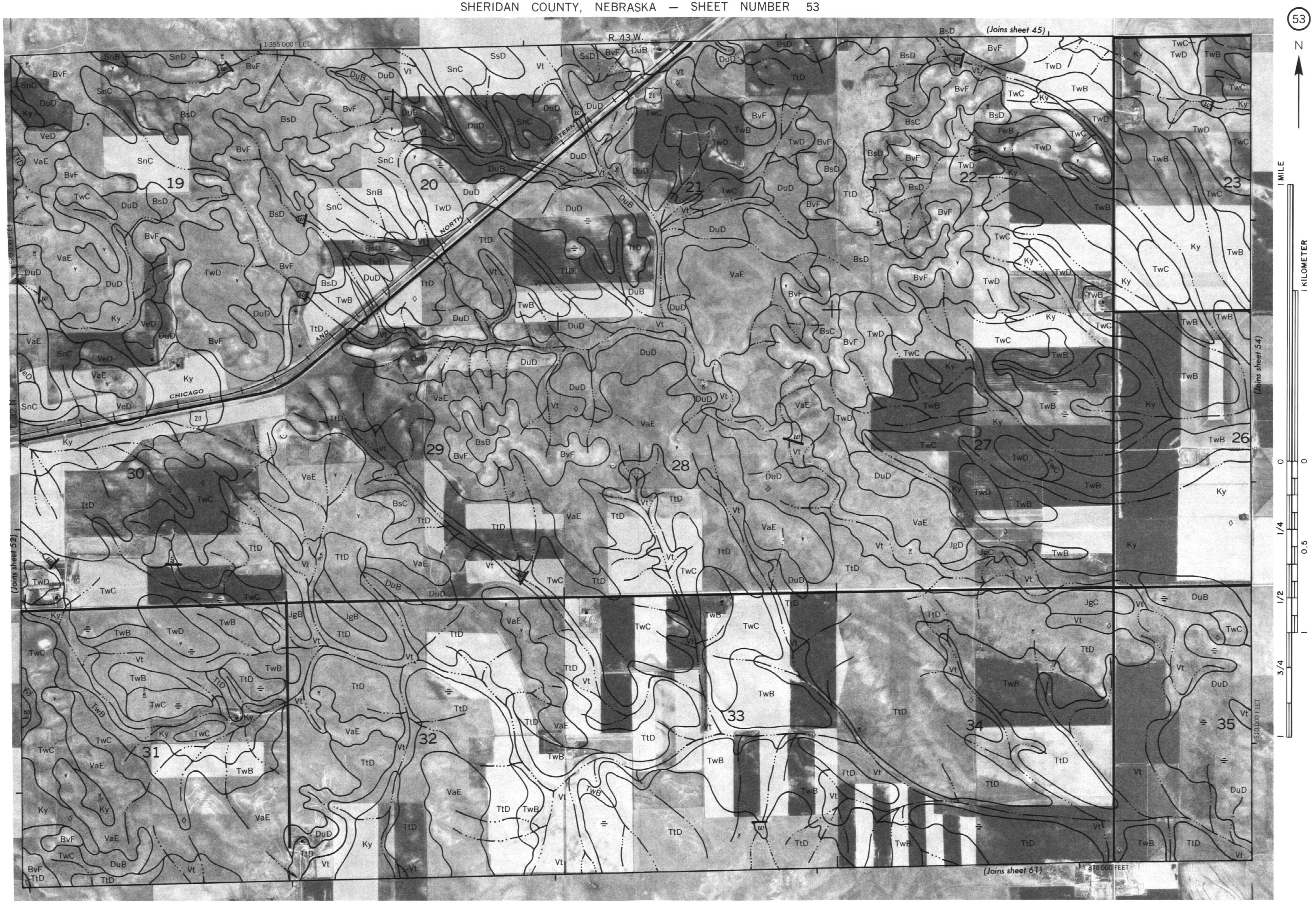


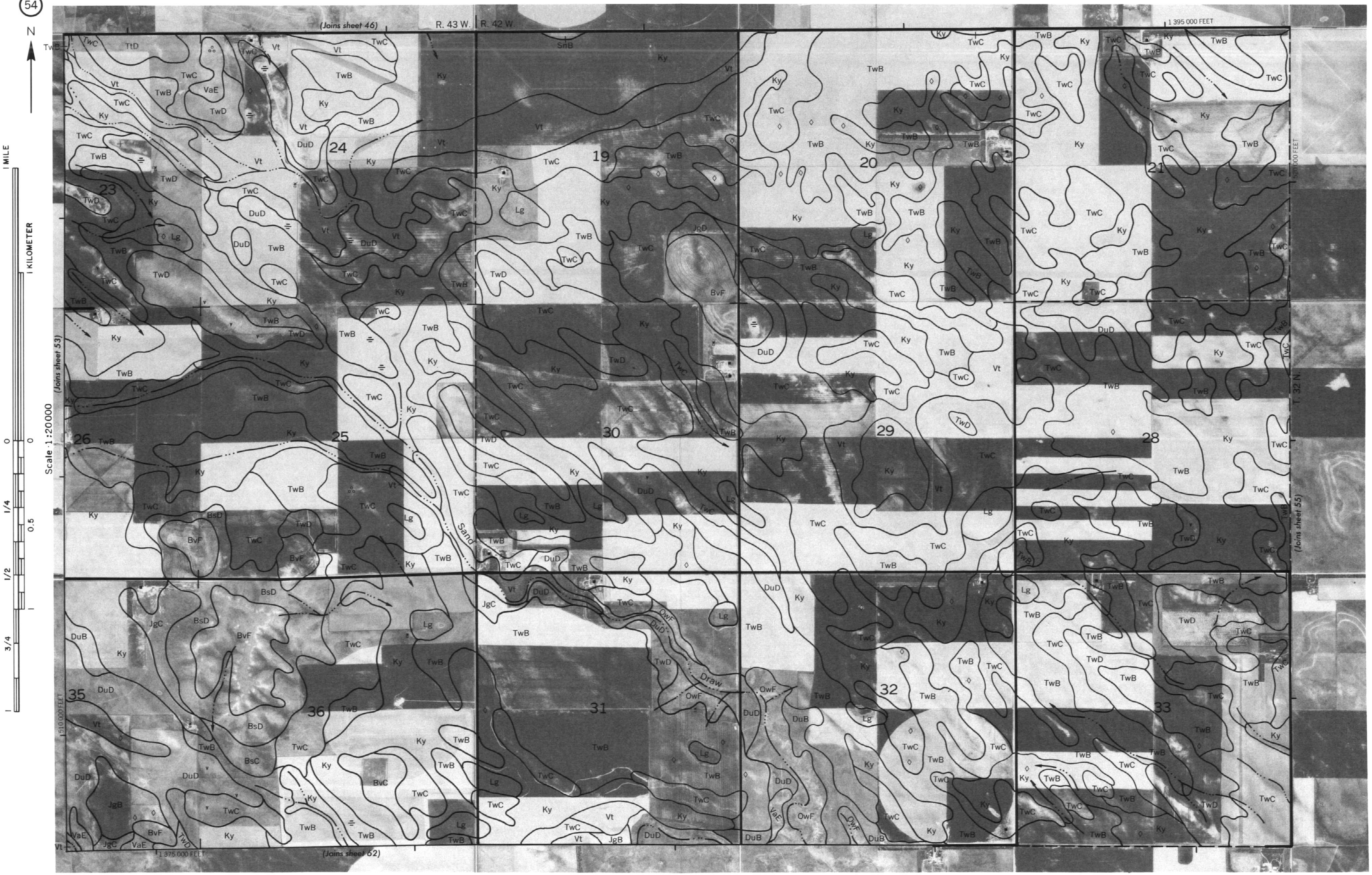
SHERIDAN COUNTY, NEBRASKA NO. 52

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

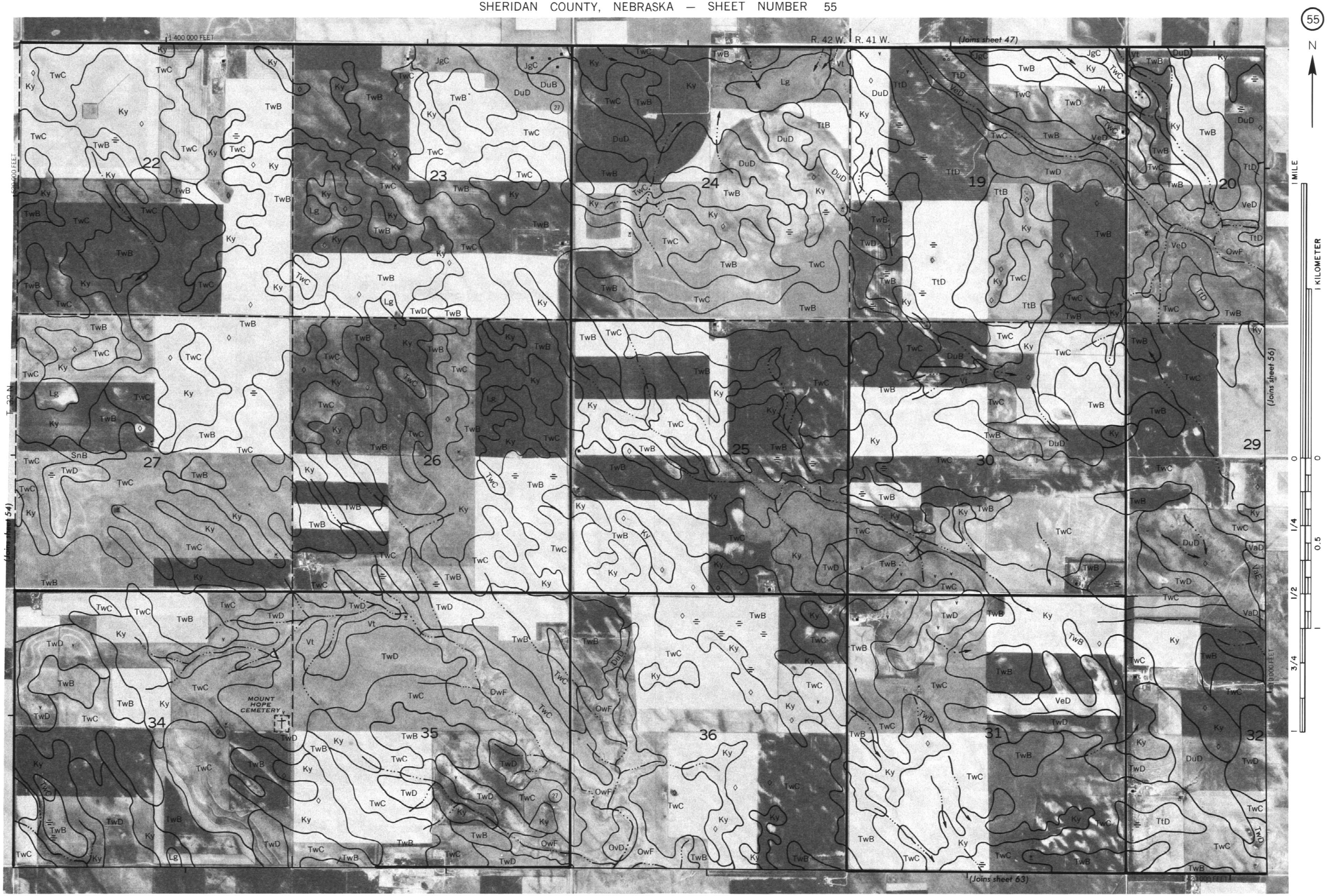
SHERIDAN COUNTY, NEBRASKA NO. 53





SHERIDAN COUNTY, NEBRASKA NO. 54

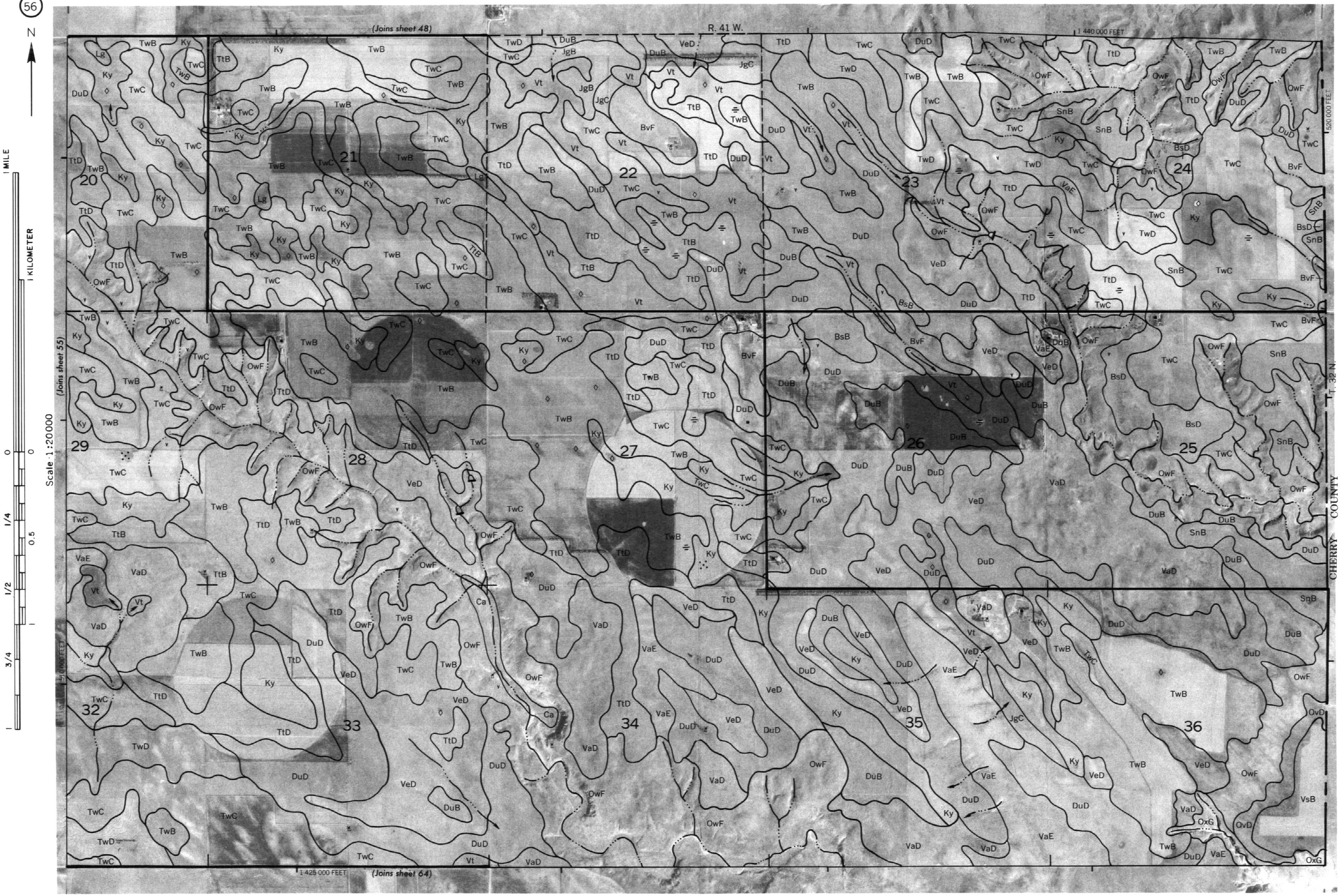
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



SHERIDAN COUNTY, NEBRASKA NO. 55

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA — SHEET NUMBER 56

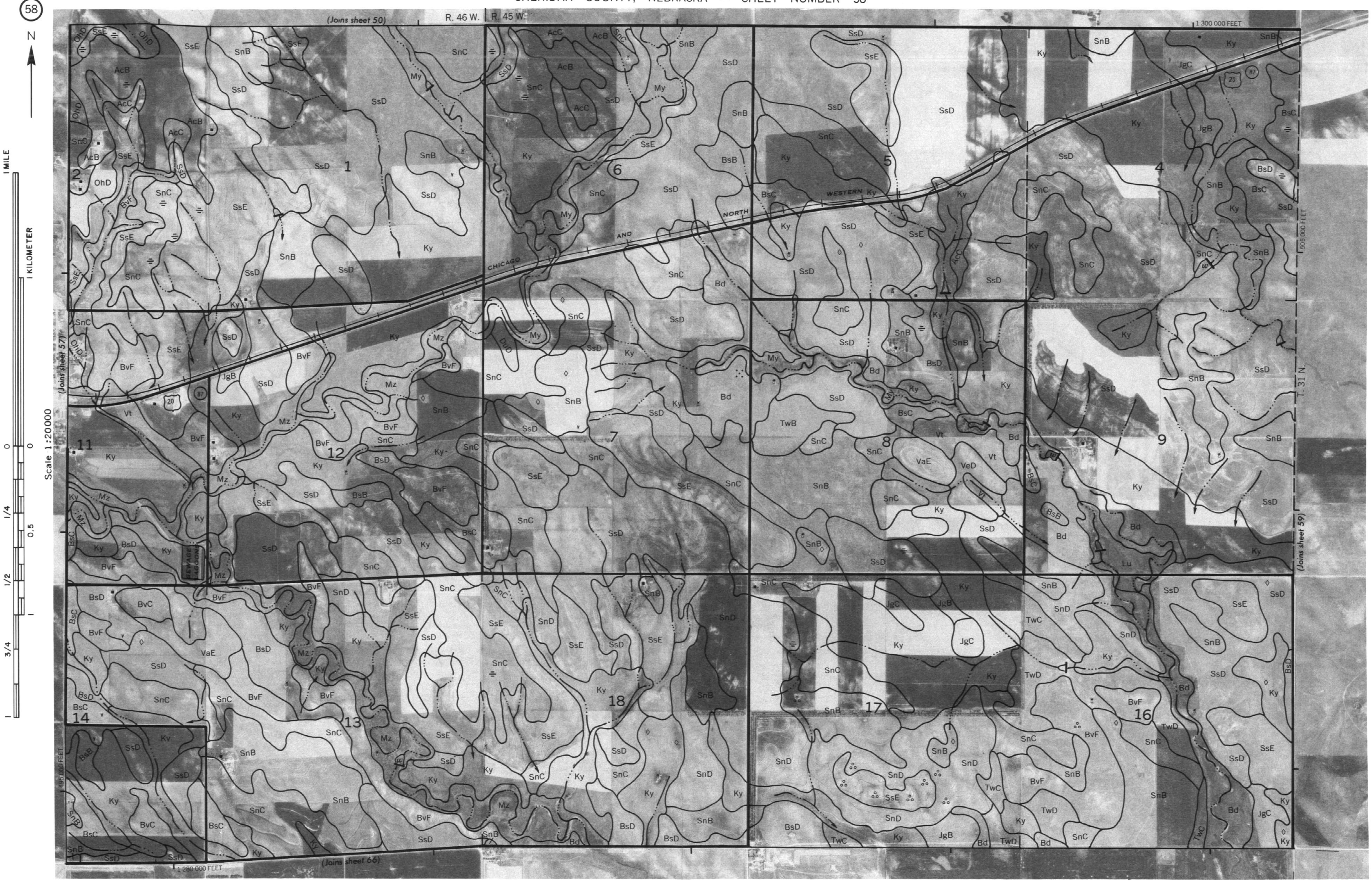


SHERIDAN COUNTY, NEBRASKA NO. 56

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

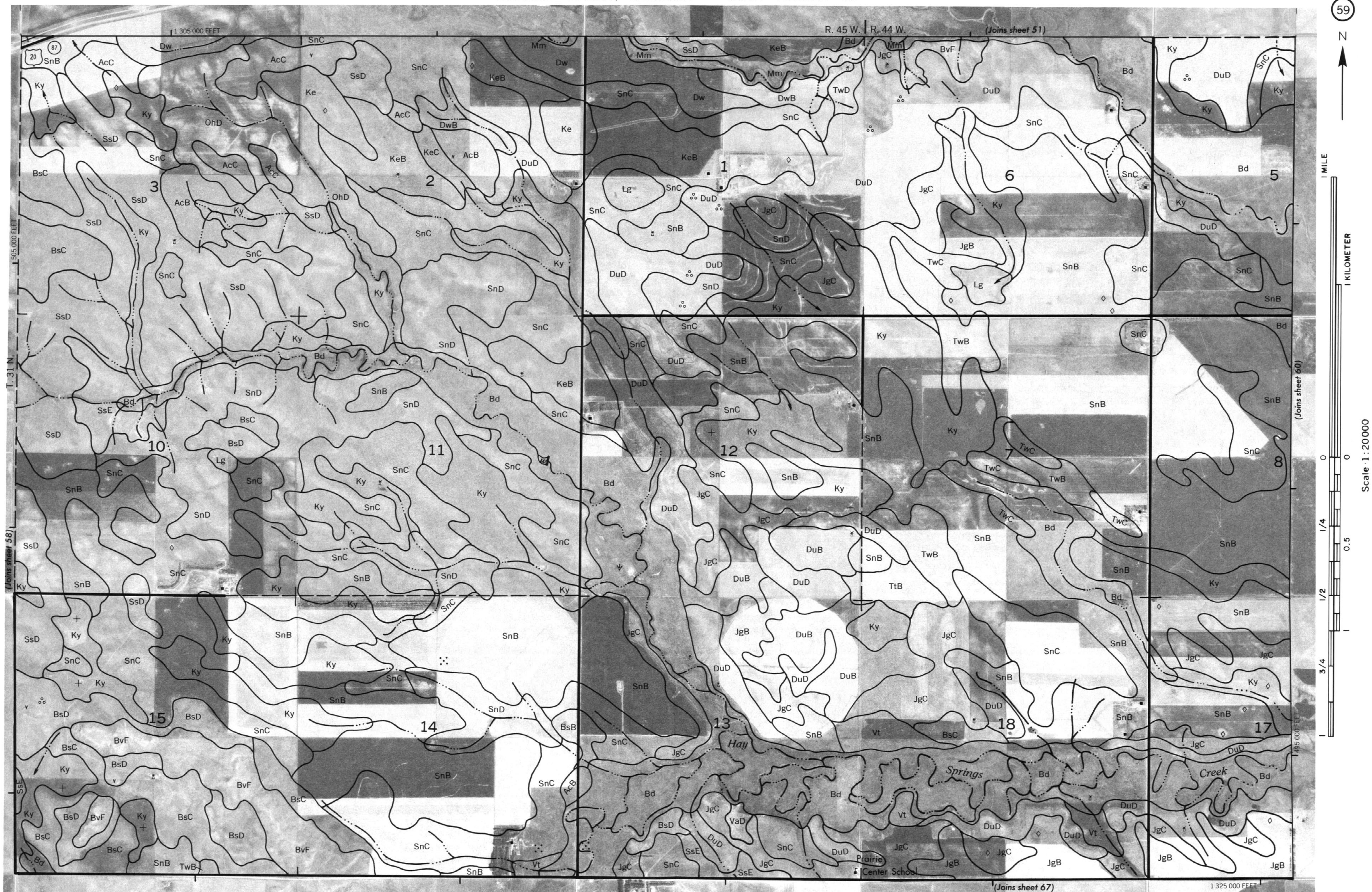
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 57



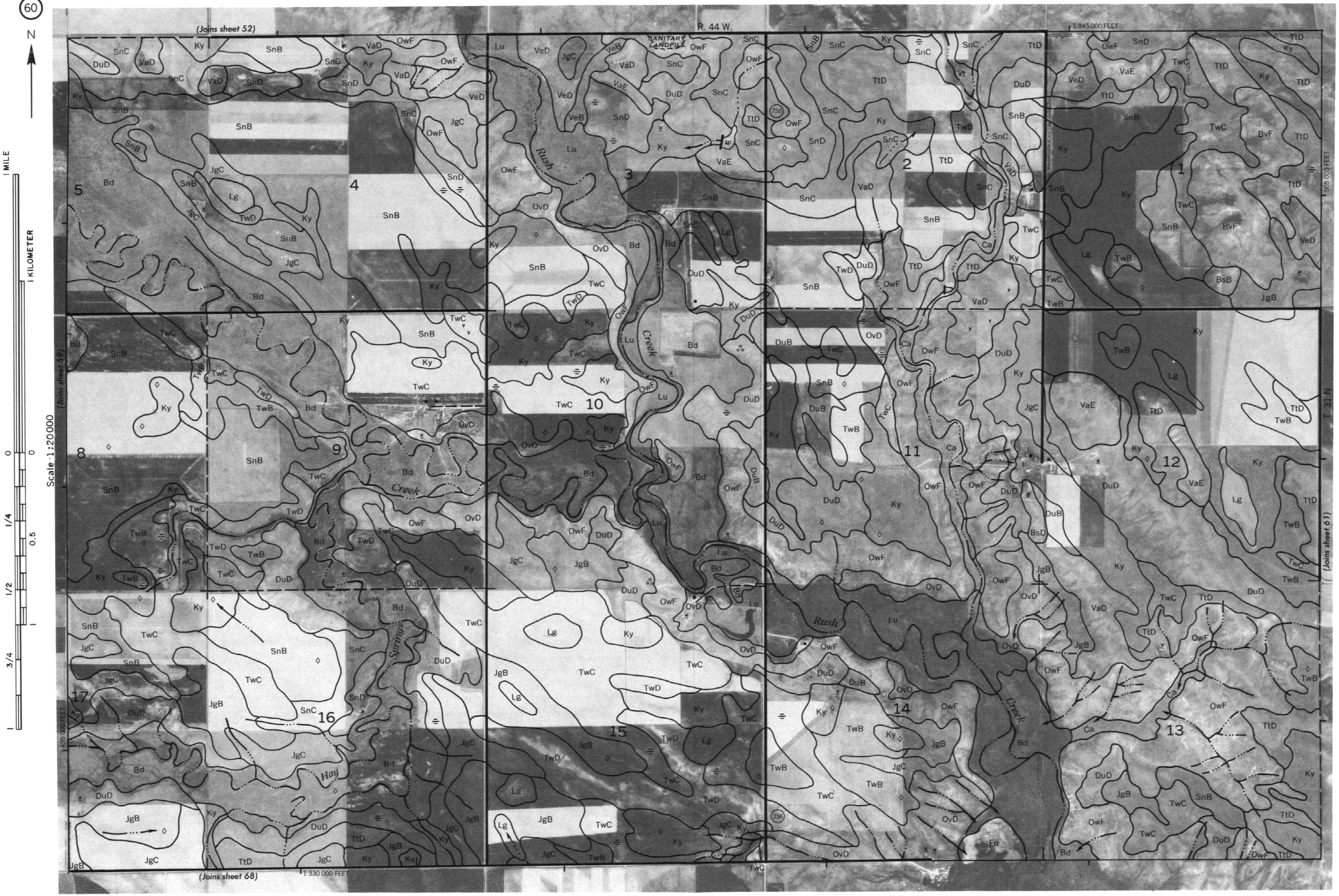
SHERIDAN COUNTY, NEBRASKA NO. 58

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



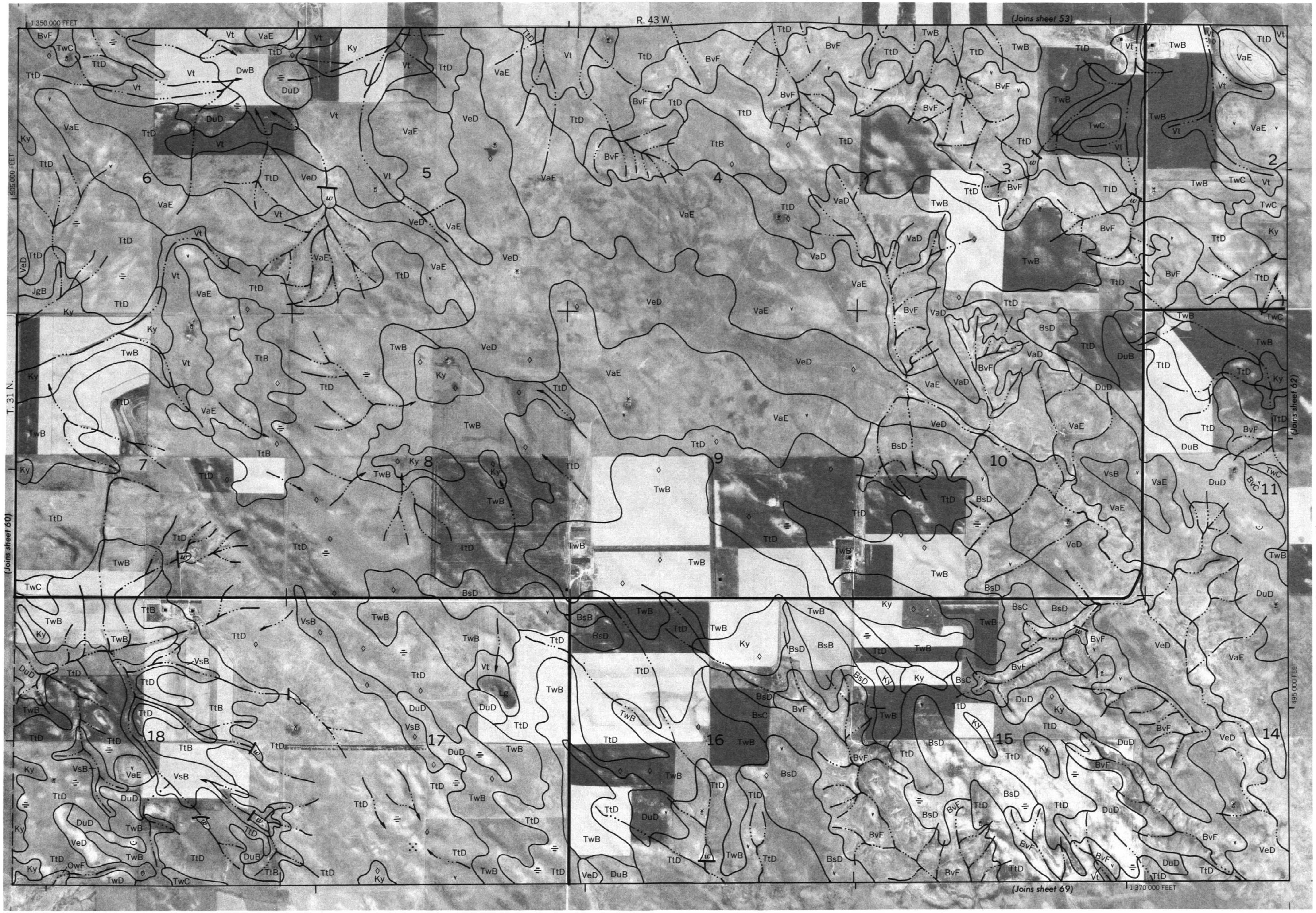
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 59



SHERIDAN COUNTY, NEBRASKA NO. 60

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



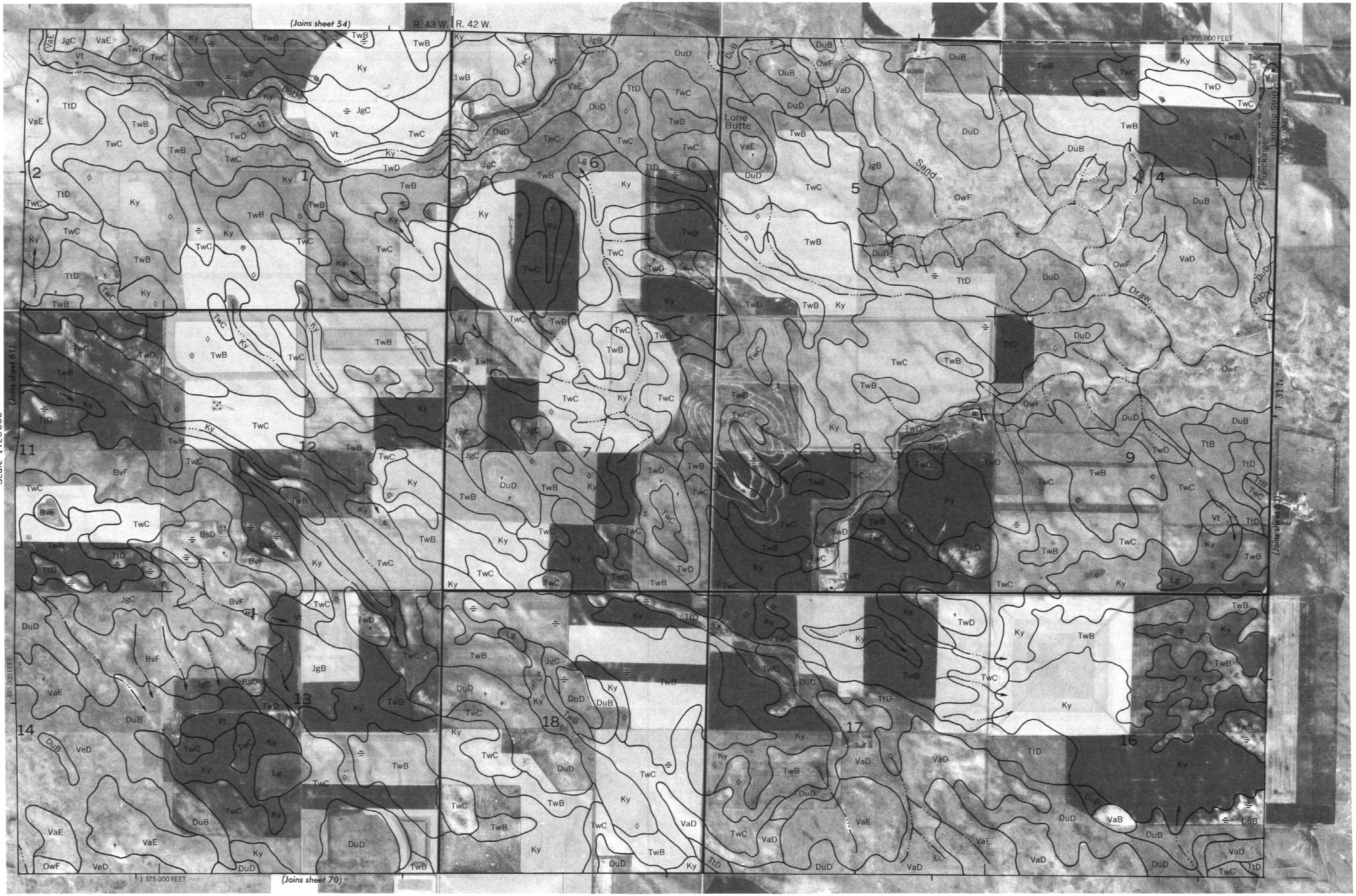
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 61

N

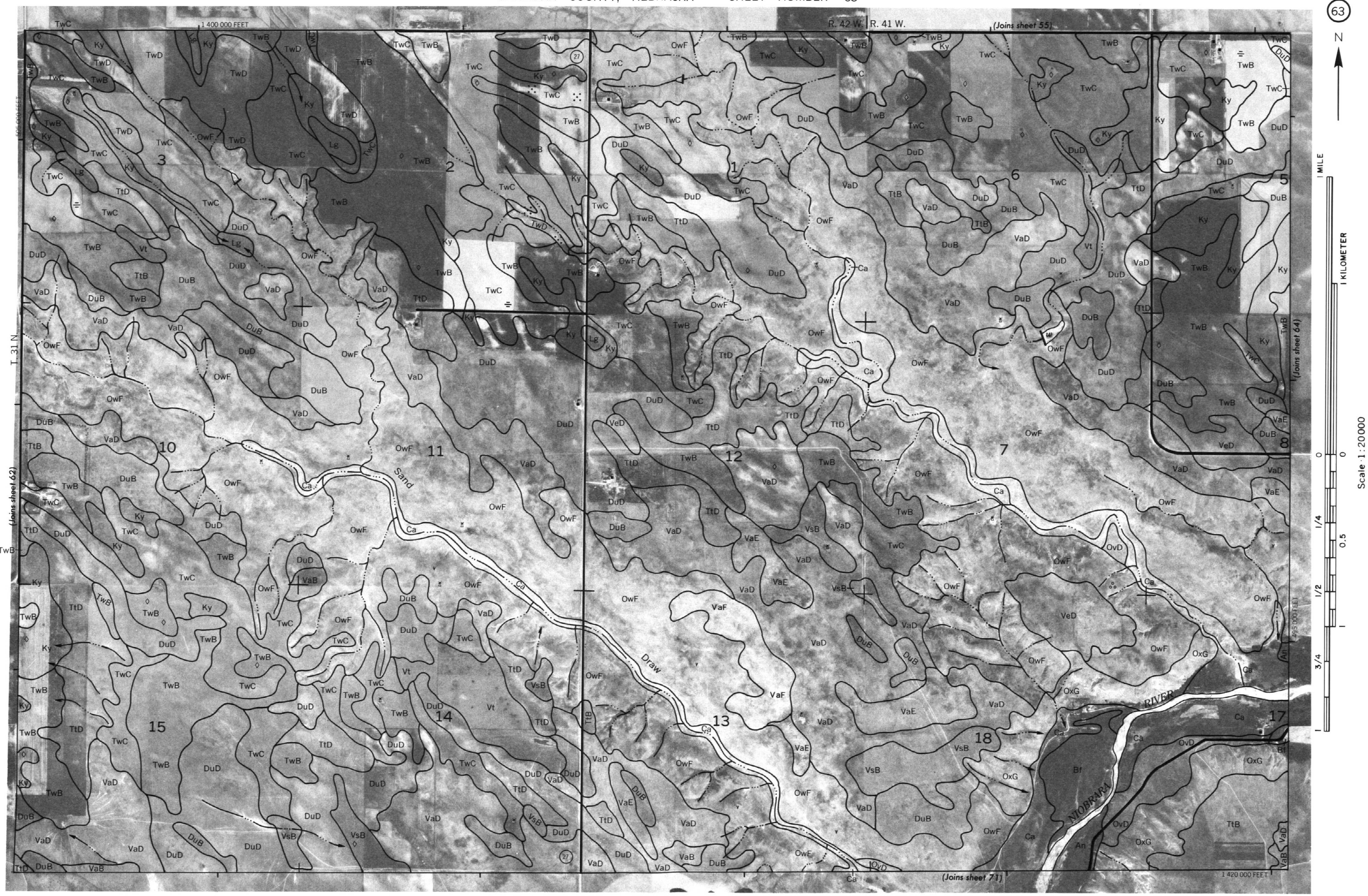
1 MILE
1 KILOMETER
0 | 1/4 | 1/2 | 3/4 | 1
0 | 0.5 | 1

Scale 1:20000



SHERIDAN COUNTY, NEBRASKA NO. 62

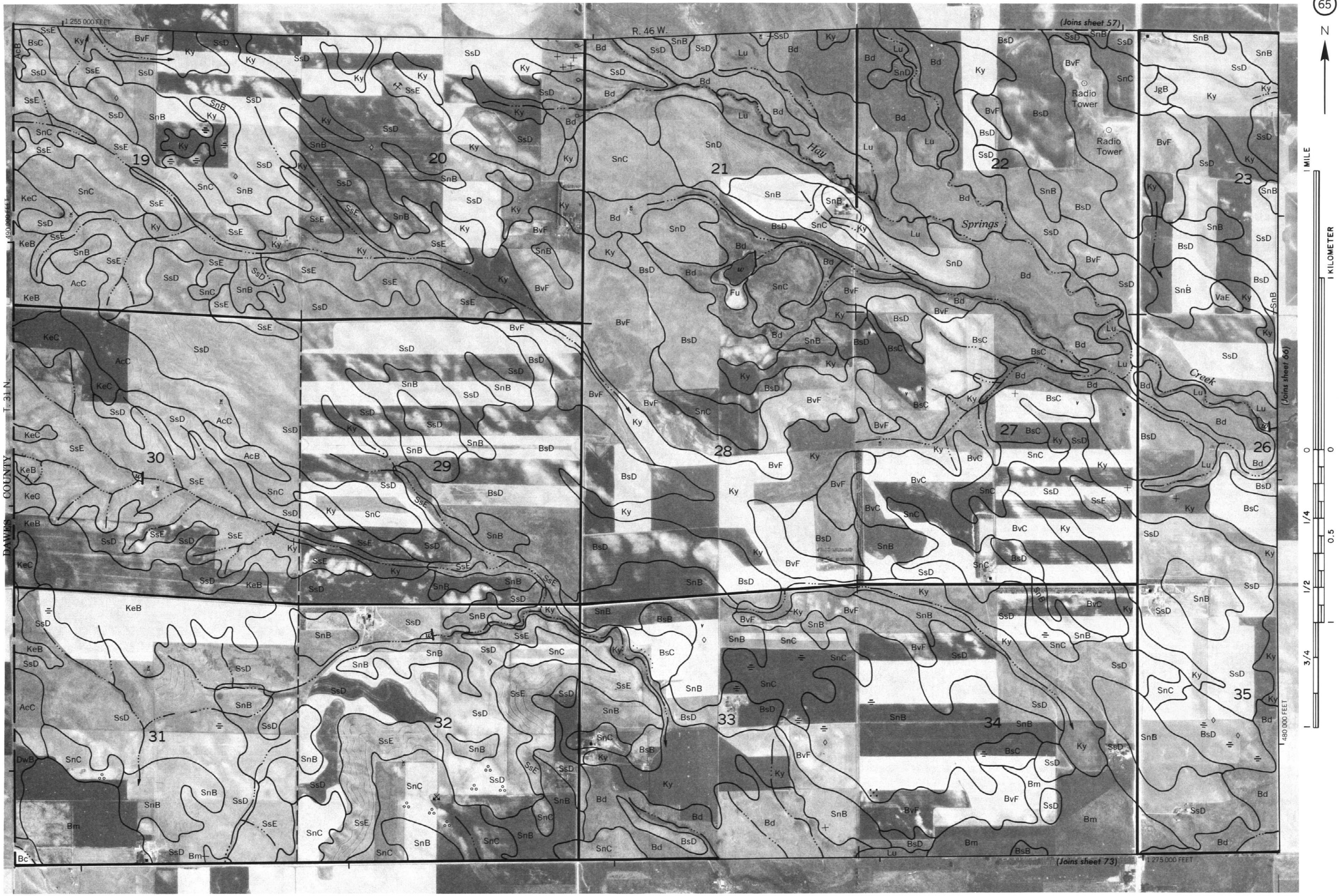
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

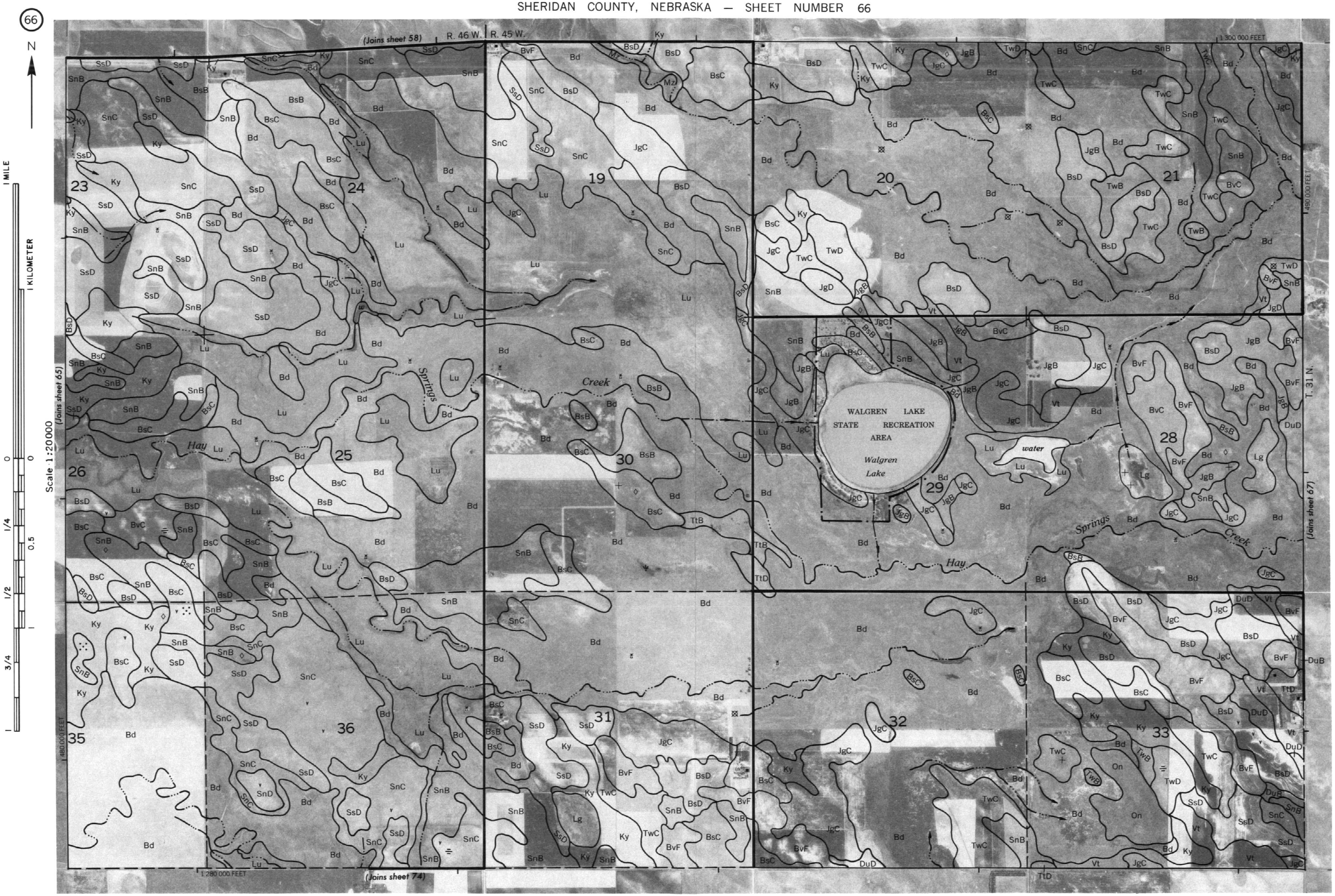
SHERIDAN COUNTY, NEBRASKA NO. 64

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



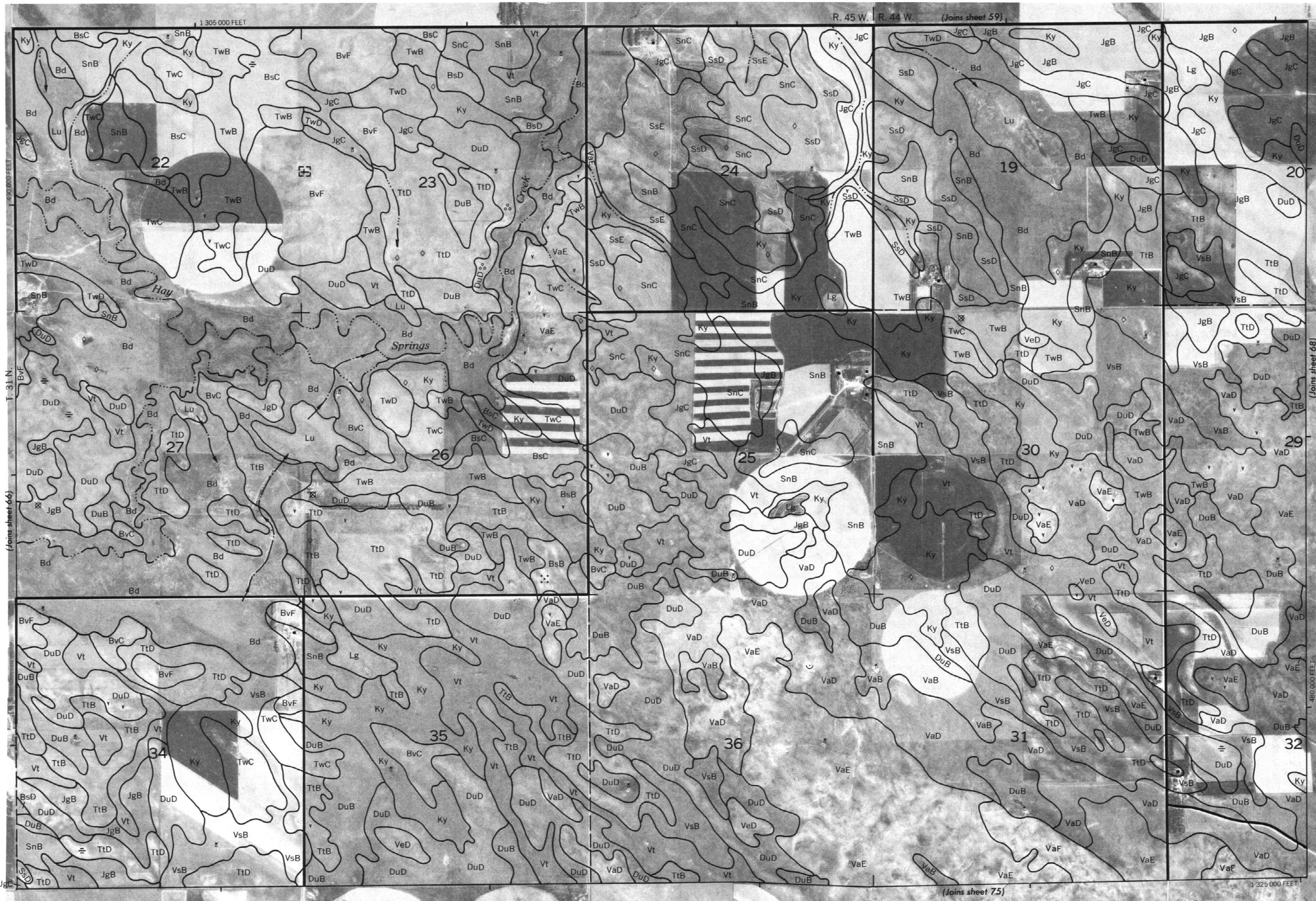
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 65



SHERIDAN COUNTY, NEBRASKA NO. 66

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



N

1 MILE

1 KILOMETER

0 | 1/4 | 1/2 | 3/4 | 1

0 | 0.5 | 1

Scale 1:20000

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 67

68

N

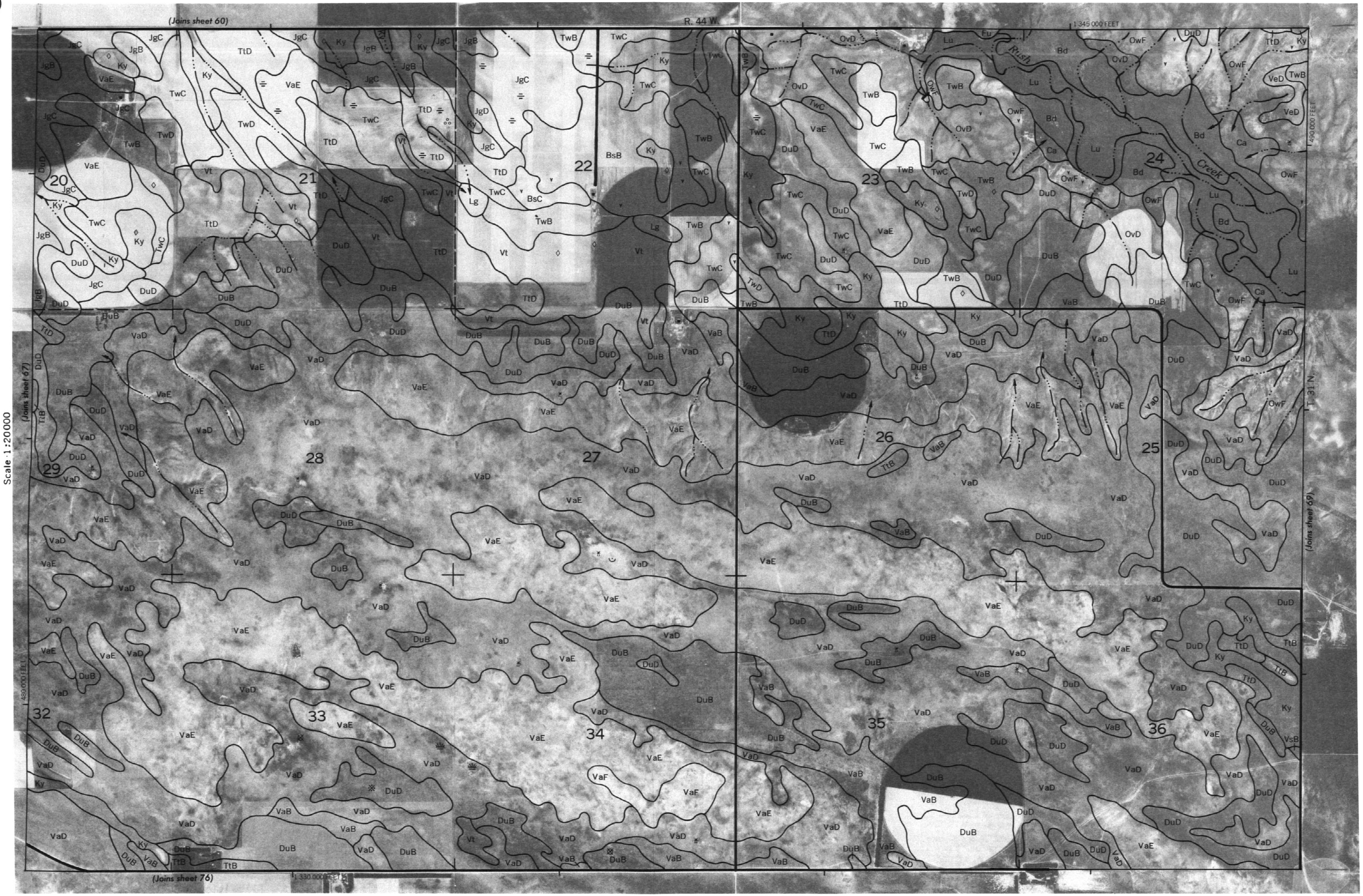
1 MILE

1 KILOMETER

Scale 1:20000

0 1/4 1/2 3/4 1

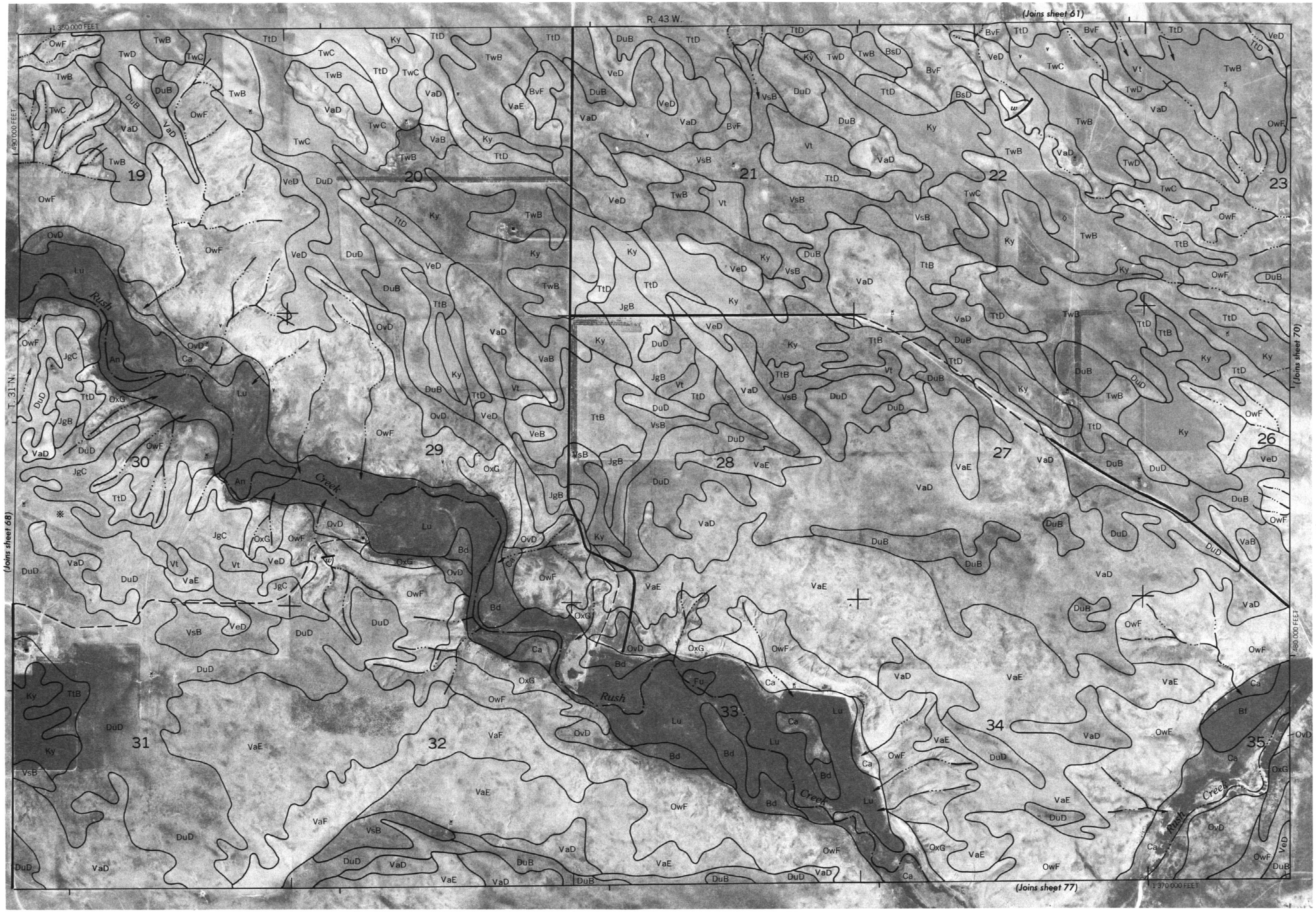
0 0.5 1



SHERIDAN COUNTY, NEBRASKA NO. 68

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

69



N

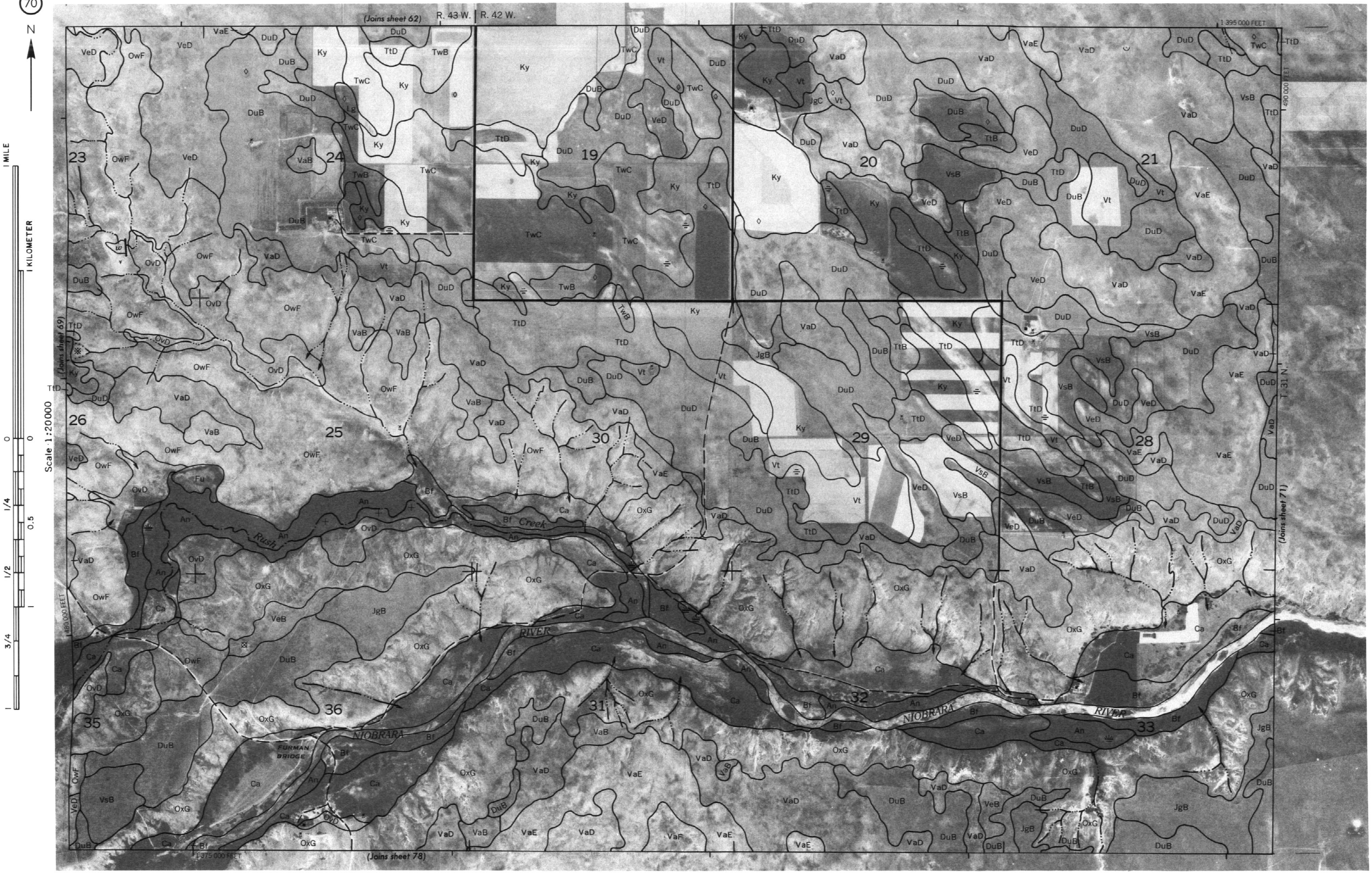
1 MILE

1 KILOMETER

Scale 1:20000

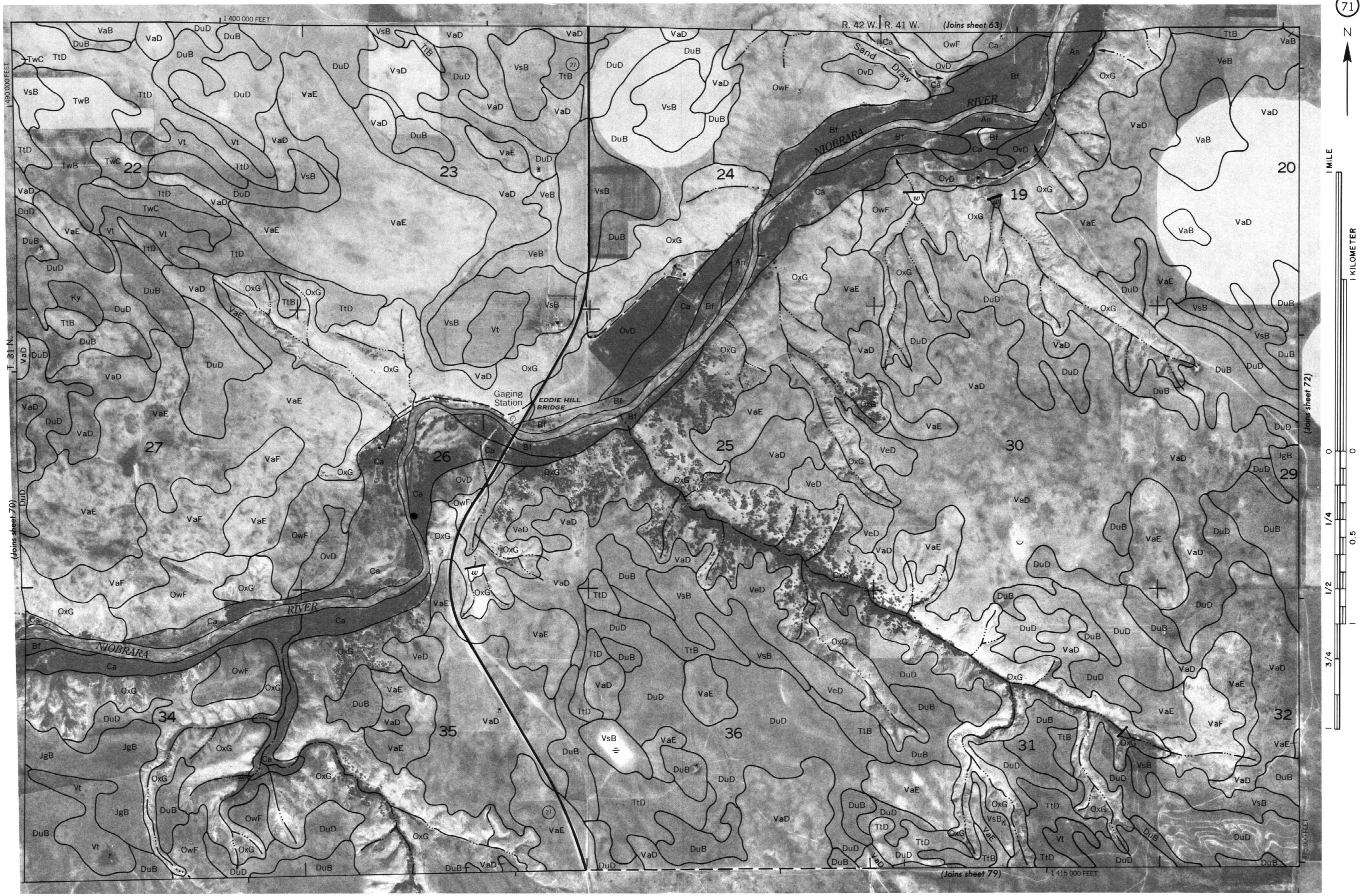
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 69



SHERIDAN COUNTY, NEBRASKA NO. 70

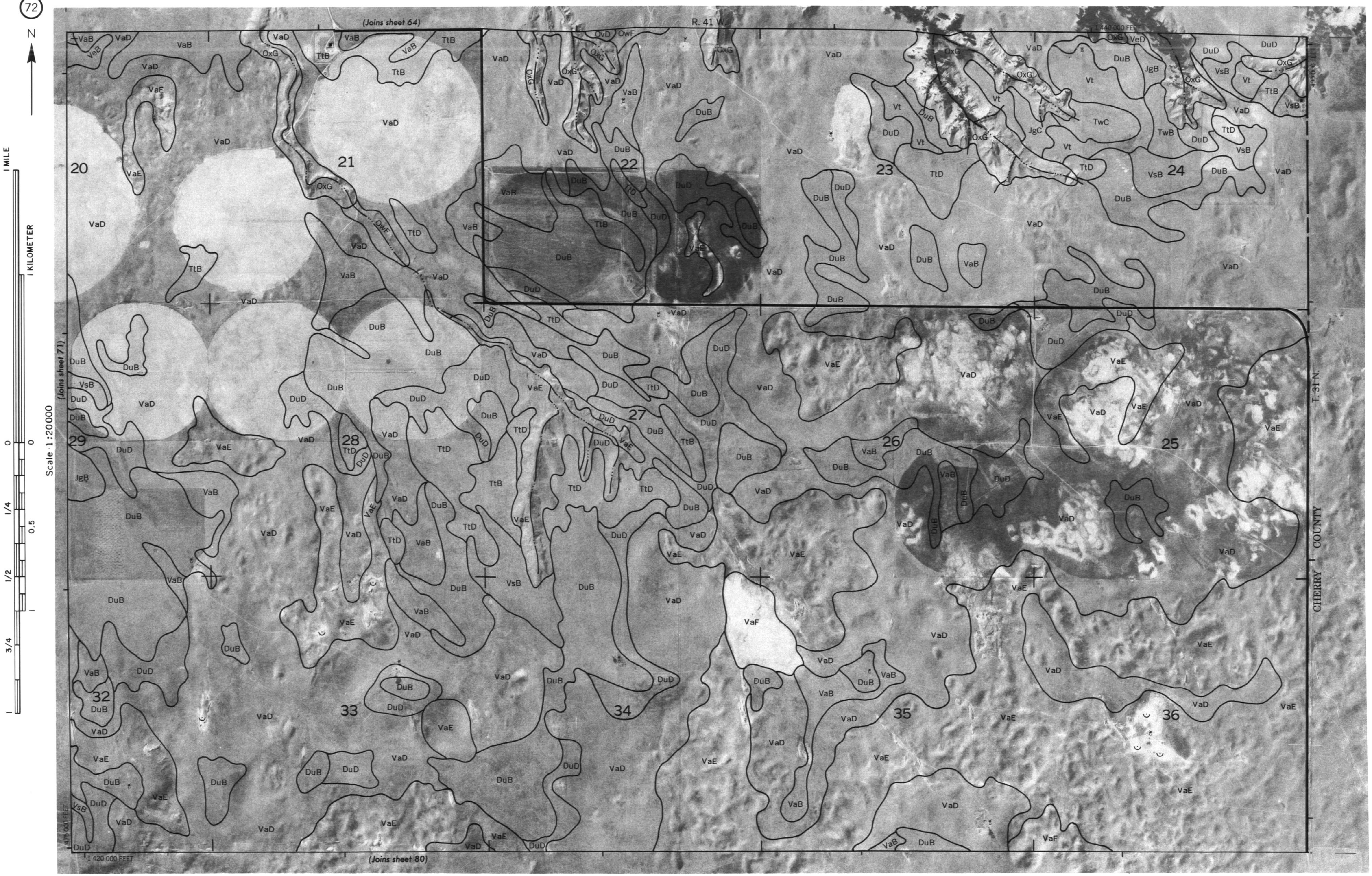
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



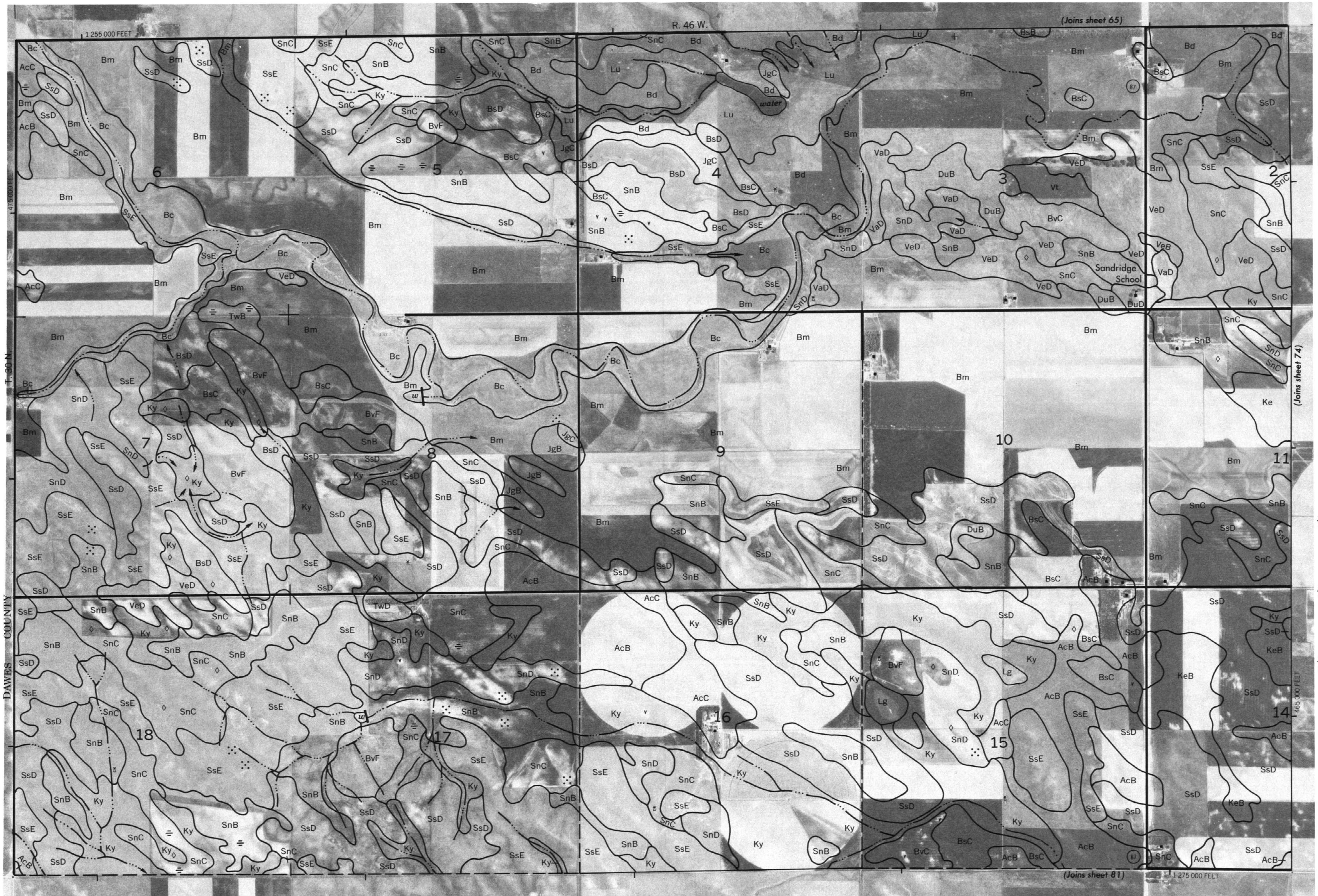
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

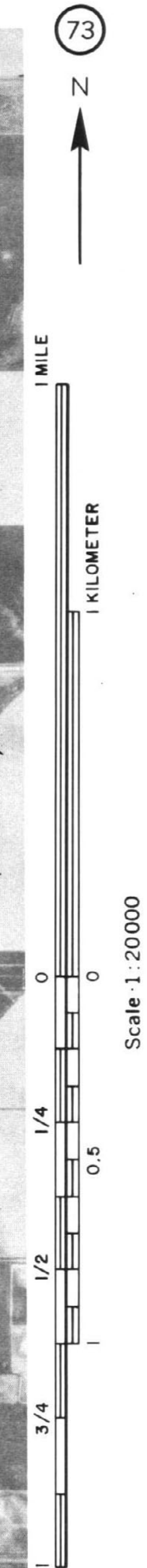
SHERIDAN COUNTY, NEBRASKA NO. 71

SHERIDAN COUNTY, NEBRASKA — SHEET NUMBER 72



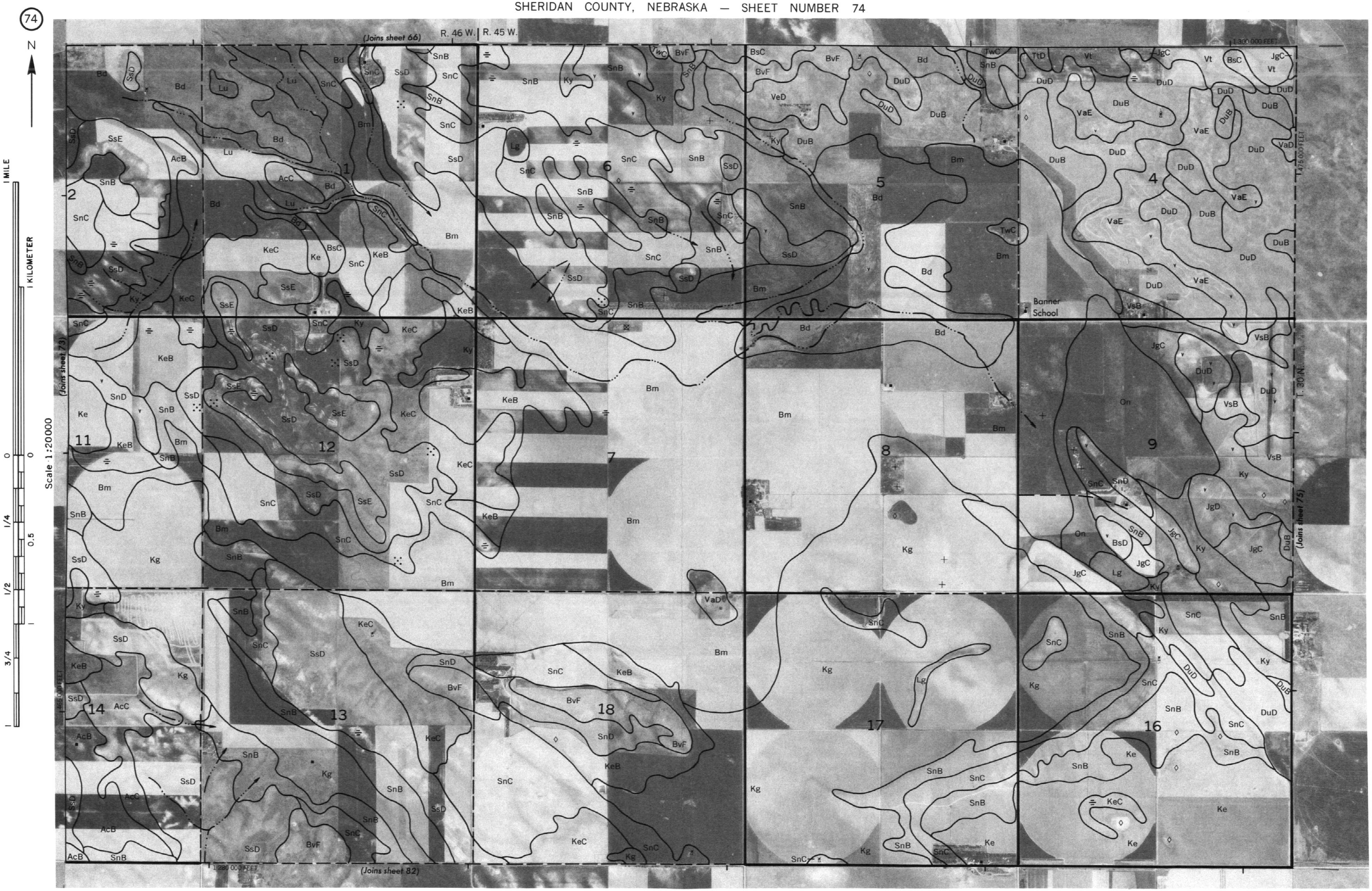
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





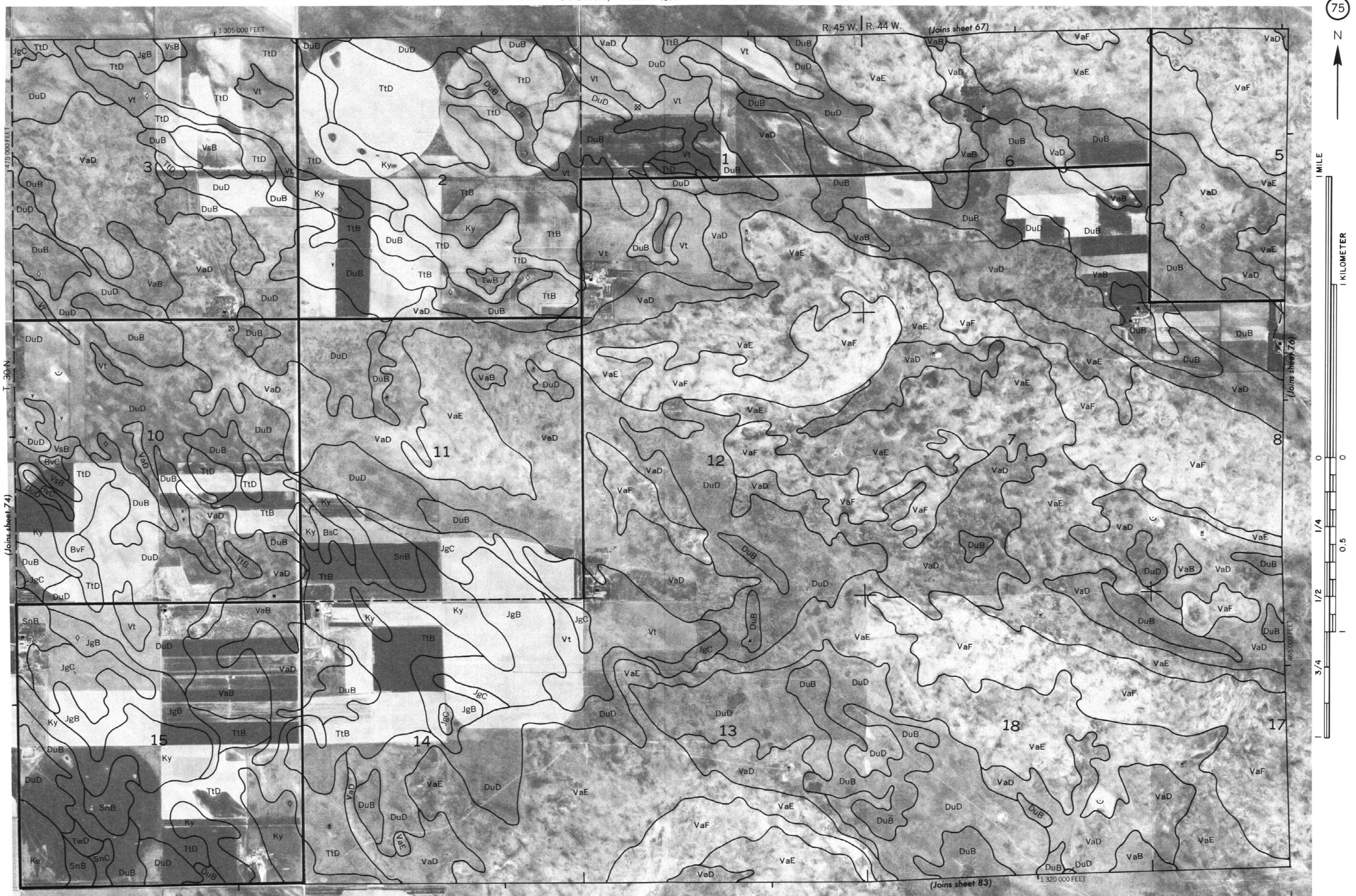
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 73



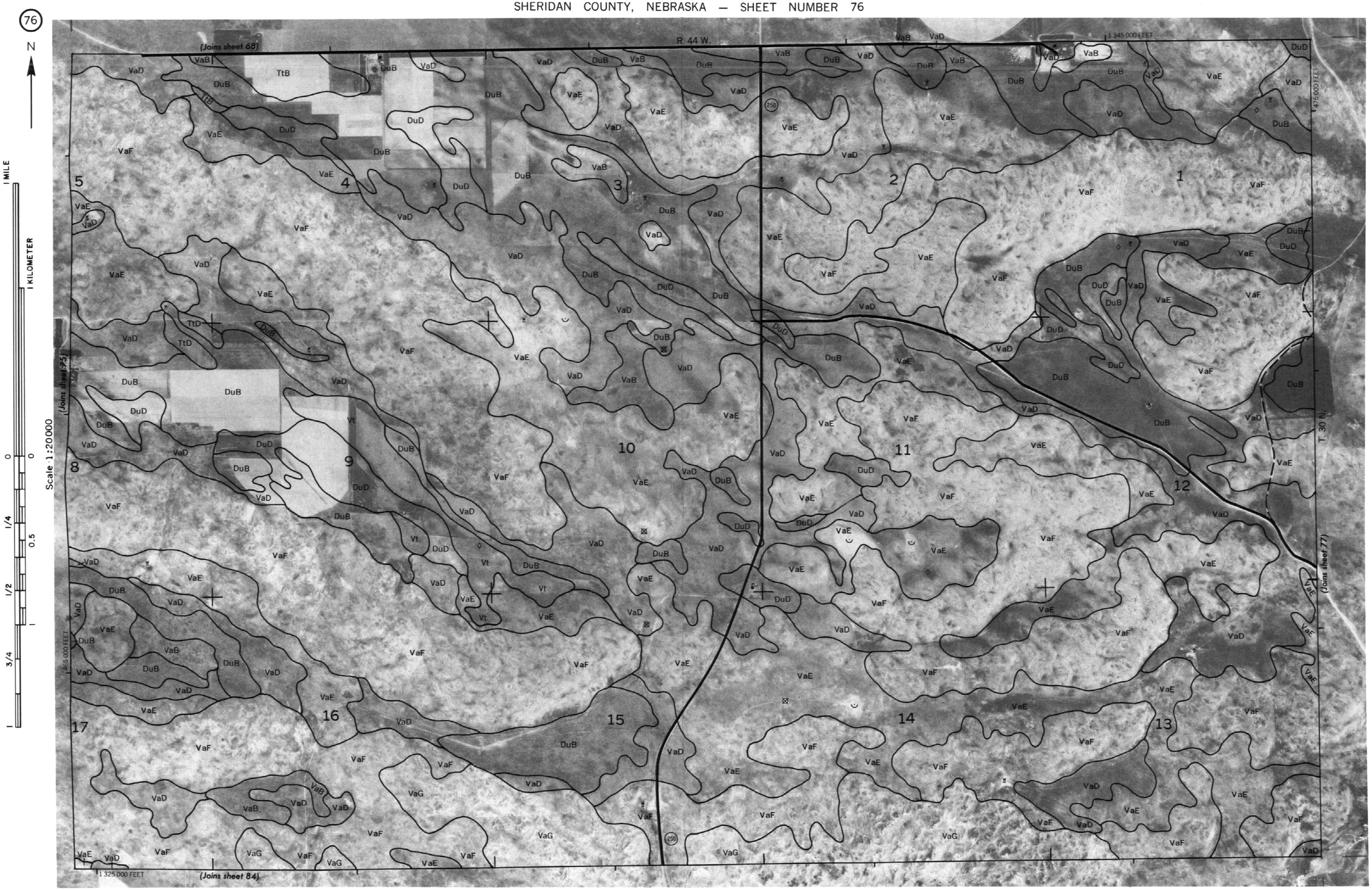
SHERIDAN COUNTY, NEBRASKA NO. 74

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 75



SHERIDAN COUNTY, NEBRASKA NO. 76

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 77

SHERIDAN COUNTY, NEBRASKA — SHEET NUMBER 78

N

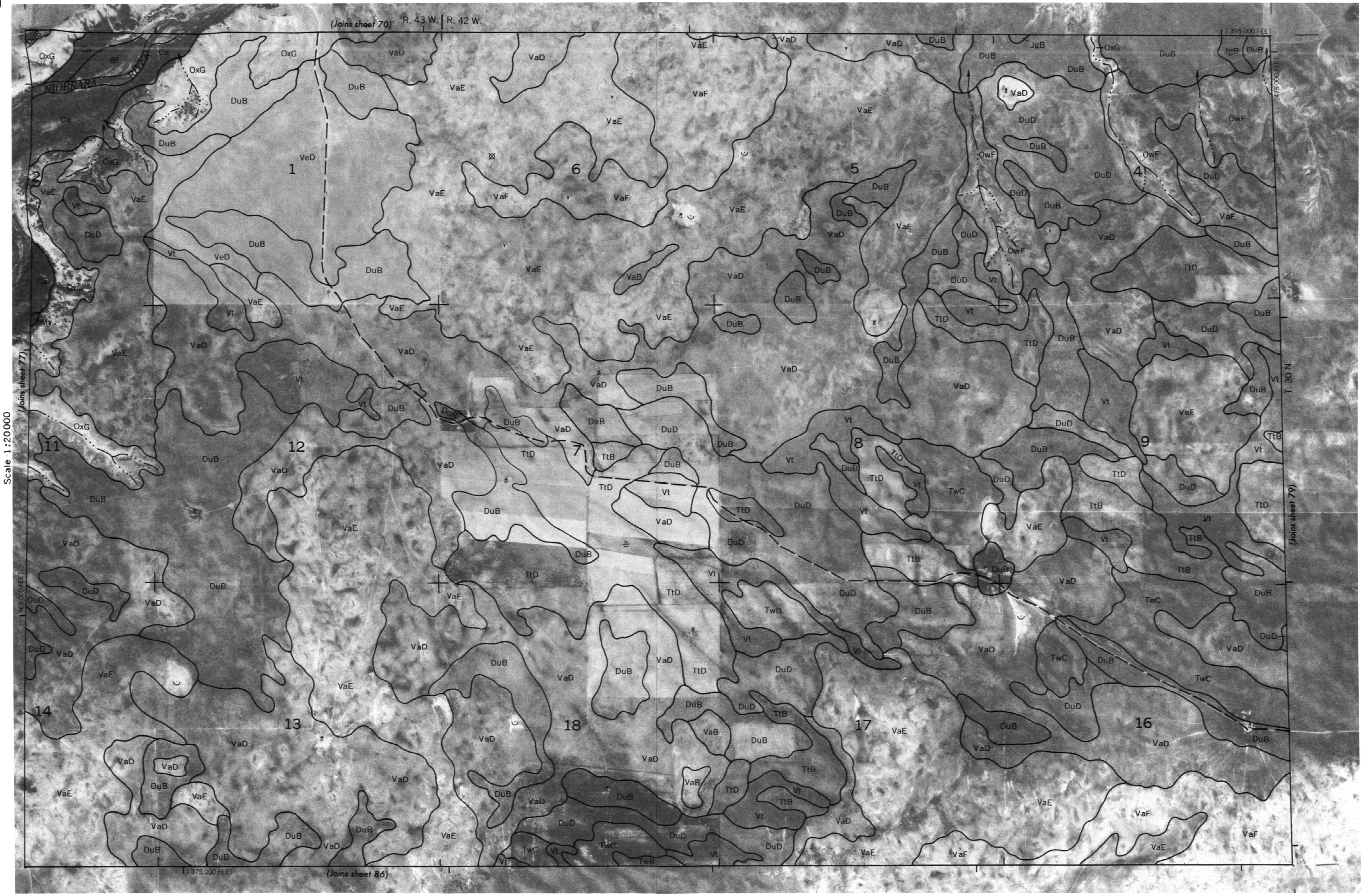
1 MILE

1 KILOMETER

Scale 1:20000

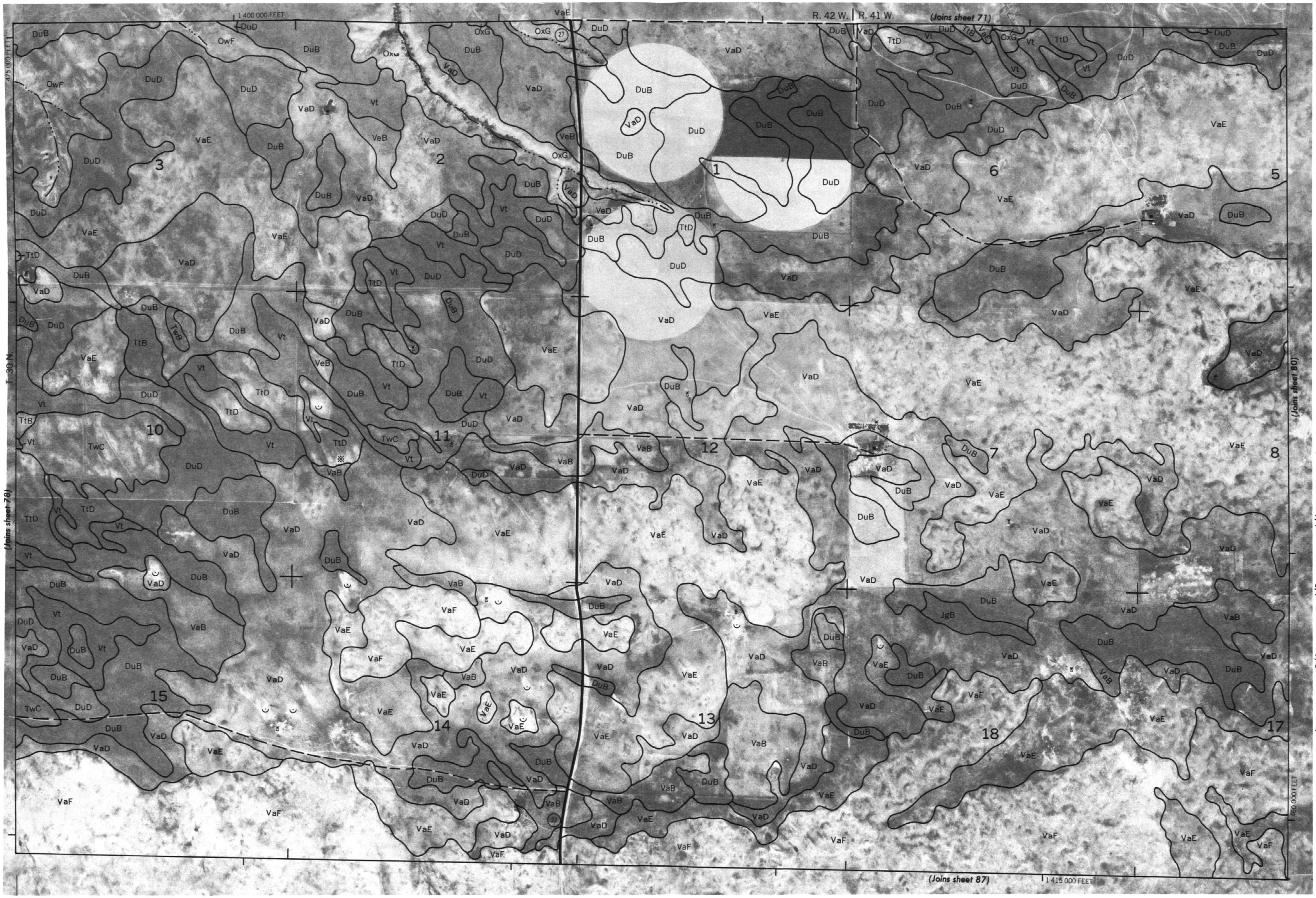
0 1/4 1/2 3/4

0 0.5 1



SHERIDAN COUNTY, NEBRASKA NO. 78

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



N

1 MILE

1 KILOMETER

0 1/4 1/2 3/4 1

0 0.5 1

Scale 1:20000

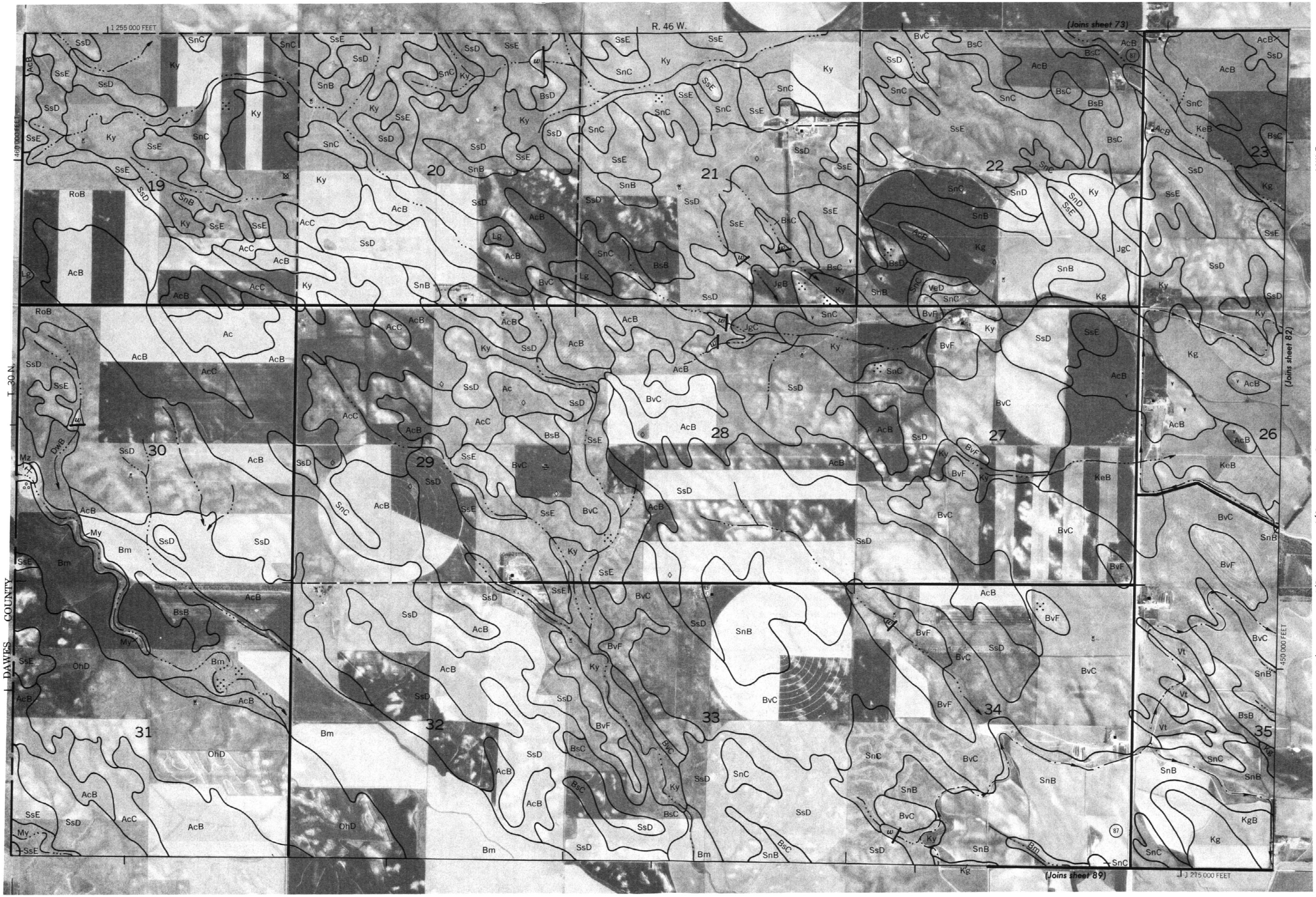
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 79

SHERIDAN COUNTY, NEBRASKA — SHEET NUMBER 80

SHERIDAN COUNTY, NEBRASKA NO. 80

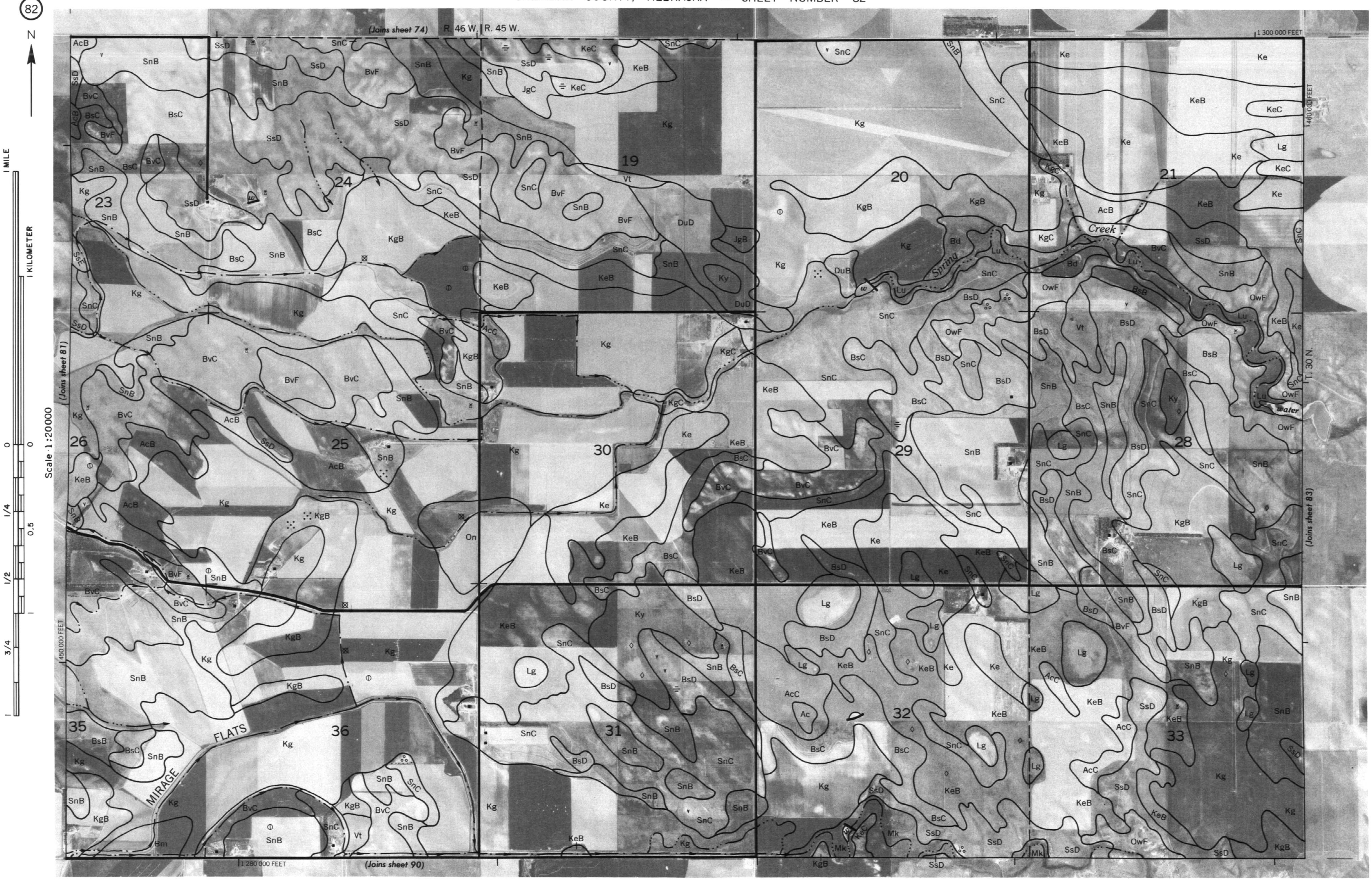
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 81

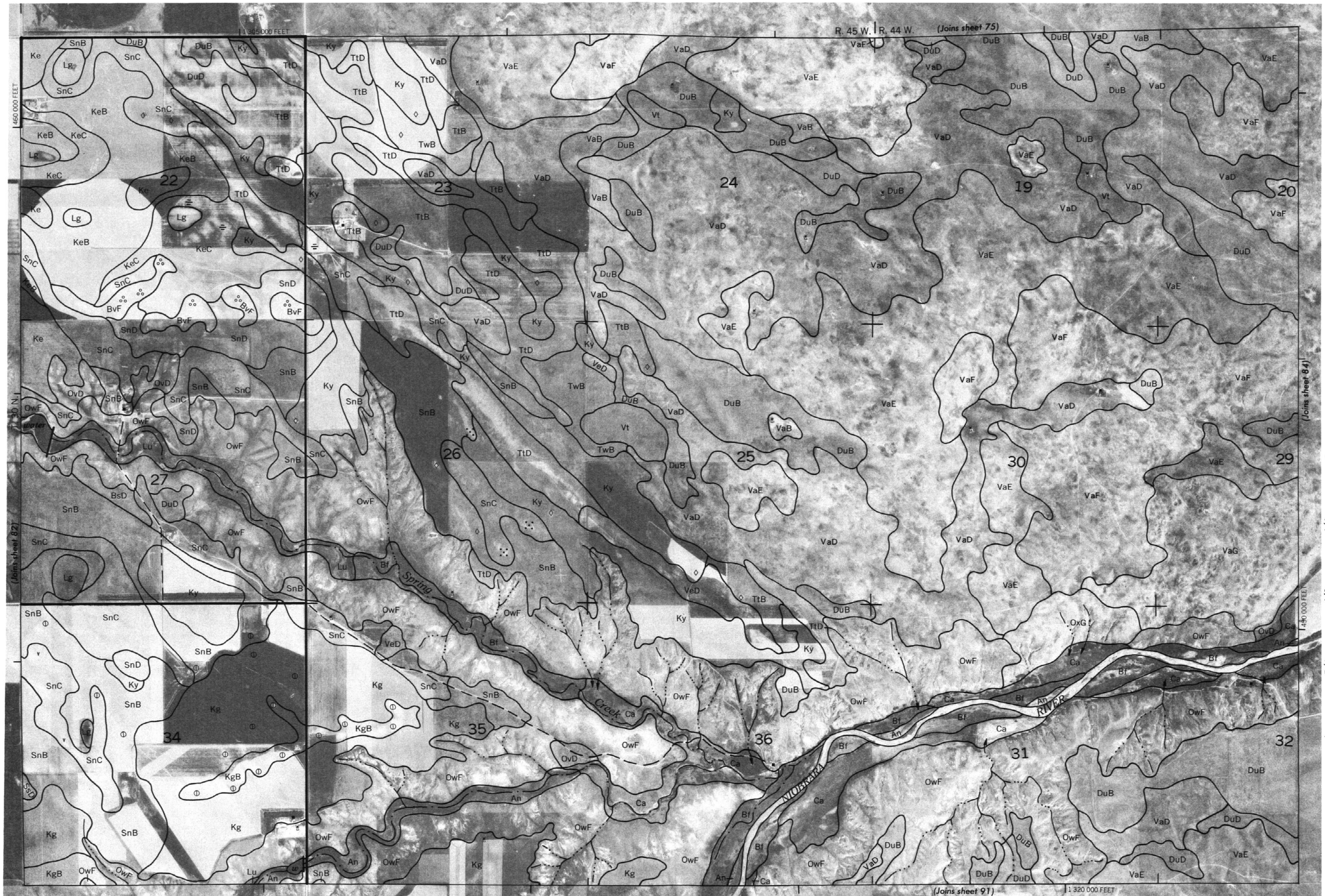
SHERIDAN COUNTY, NEBRASKA — SHEET NUMBER 82



SHERIDAN COUNTY, NEBRASKA NO. 82

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

83



SHERIDAN COUNTY, NEBRASKA NO. 83

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

N

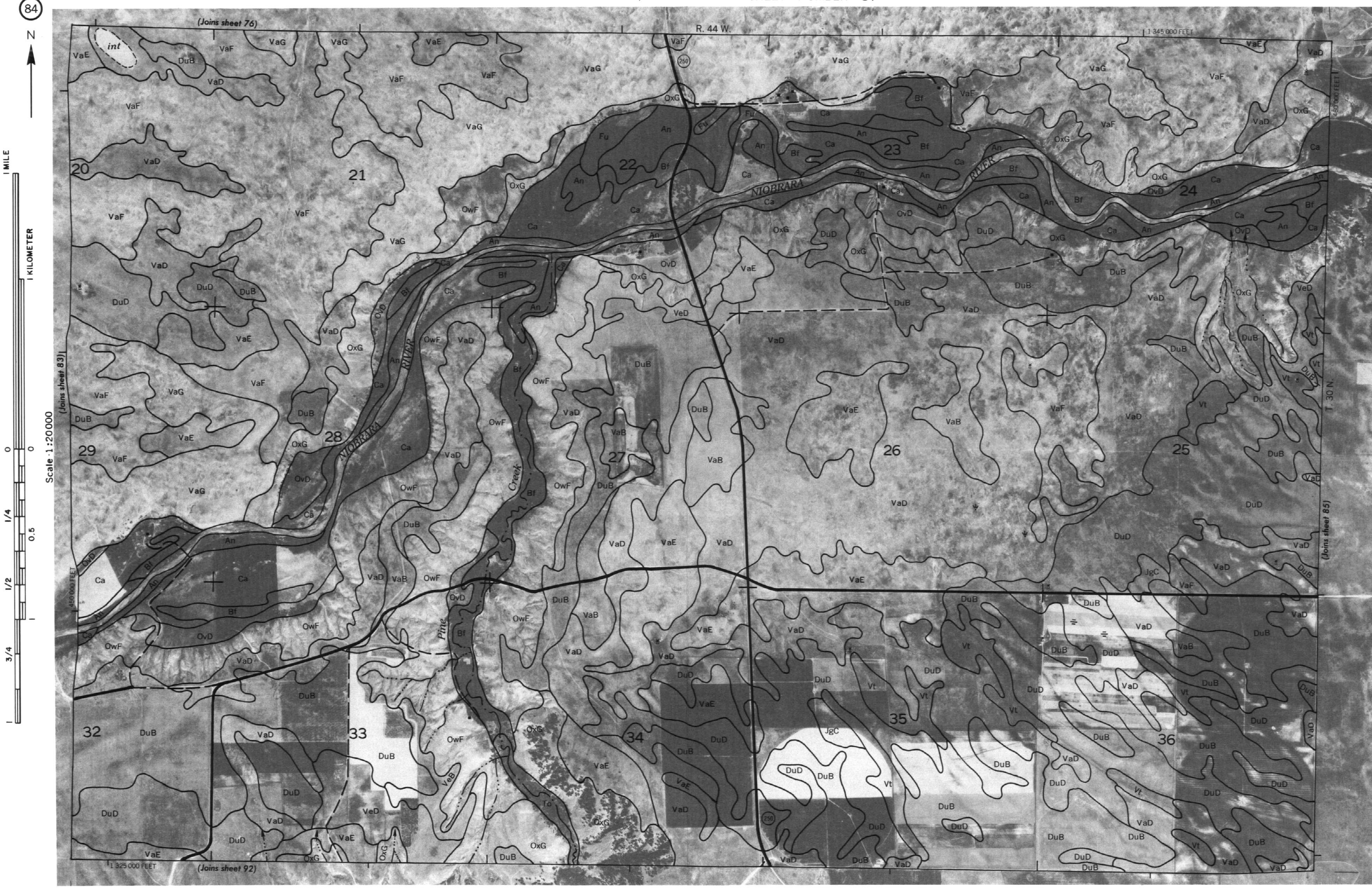
1 MILE

1 KILOMETER

0 1/4 1/2 3/4 1

0 0.5 1

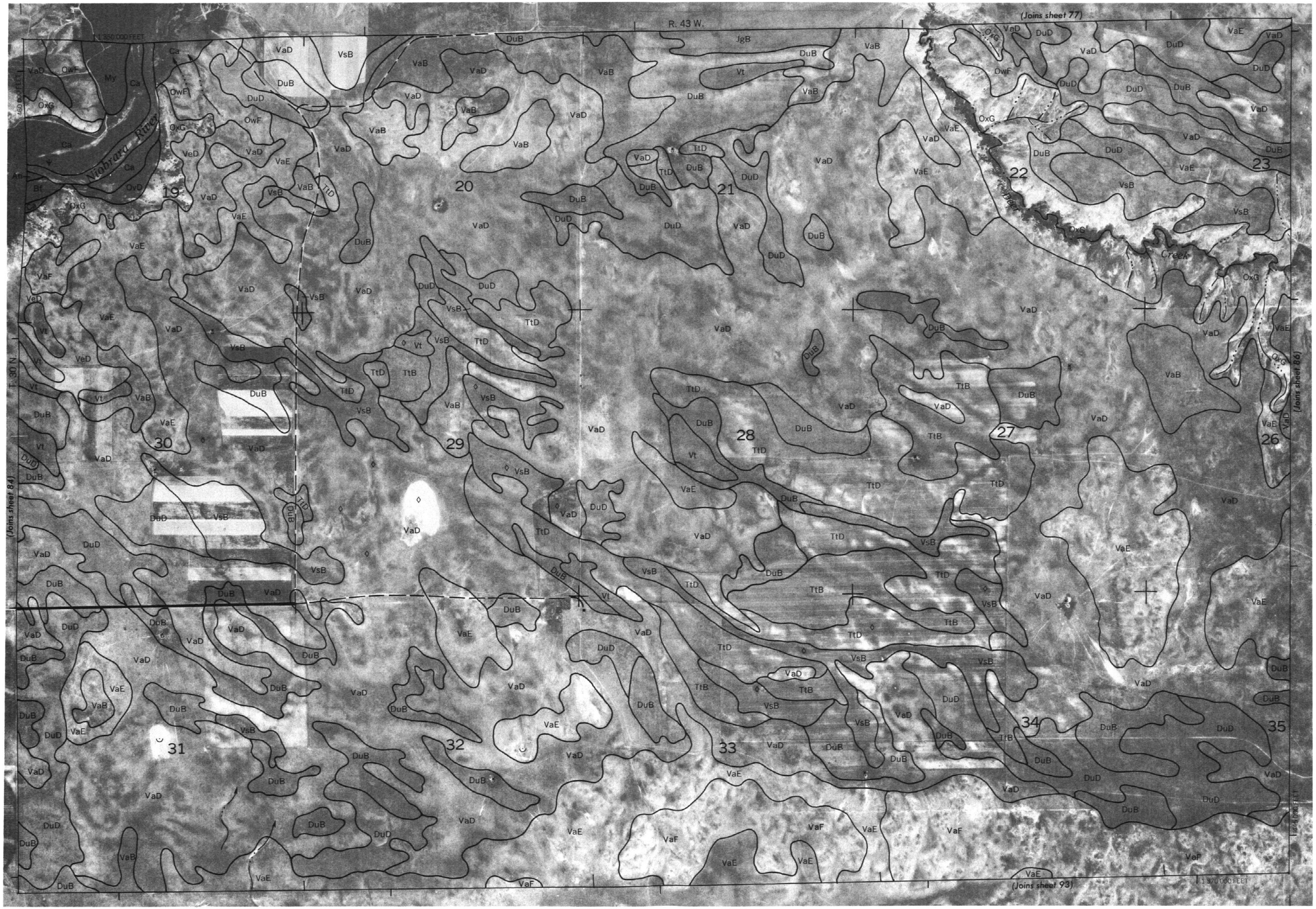
Scale 1:20000



SHERIDAN COUNTY, NEBRASKA NO. 84

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned

85



N

1 MILE

1 KILOMETER

0 1/4 1/2 3/4 1

0 0.5 1

Scale 1:20000

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 85

86

N

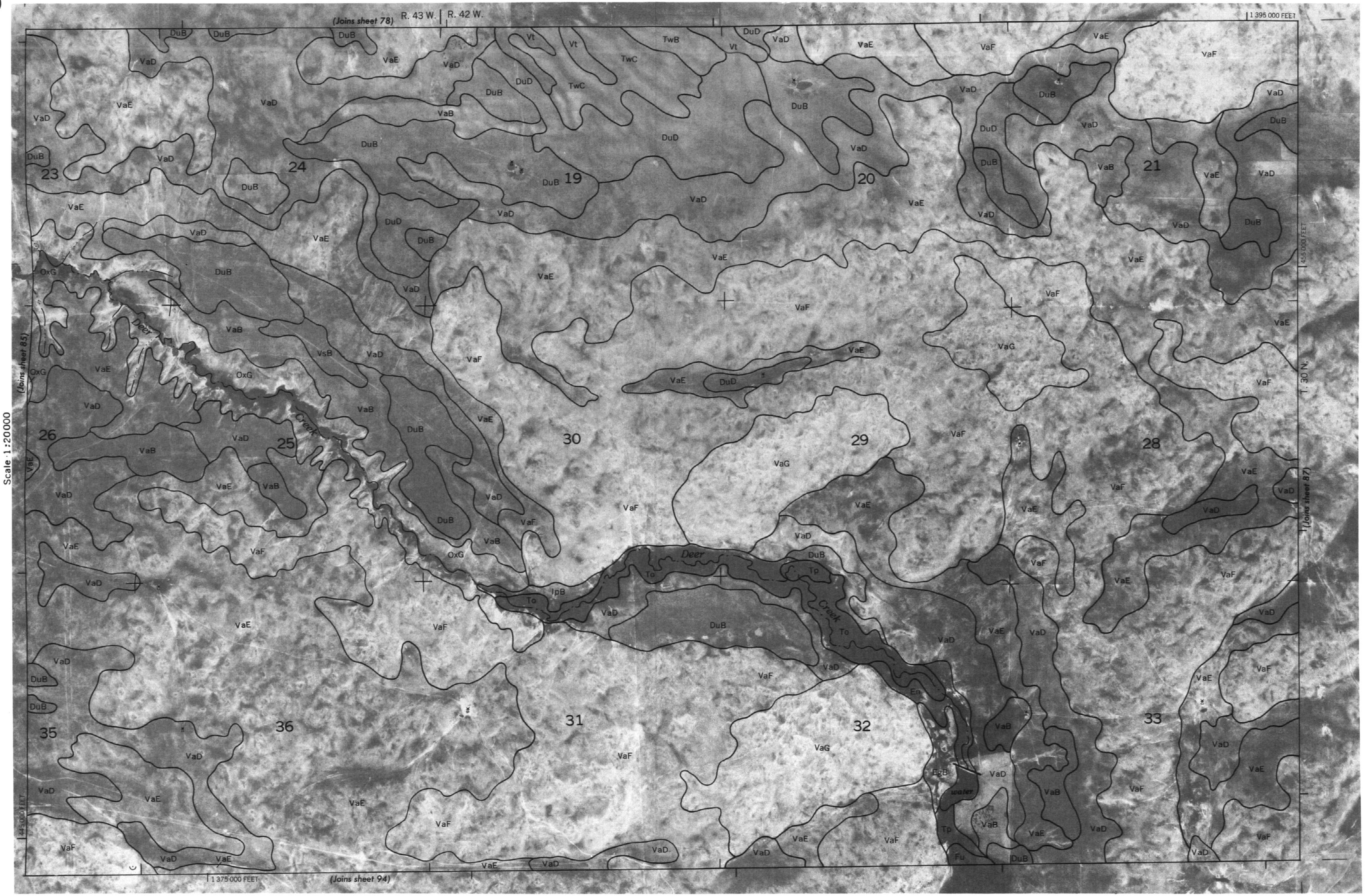
1 MILE

1 KILOMETER

Scale 1:20000

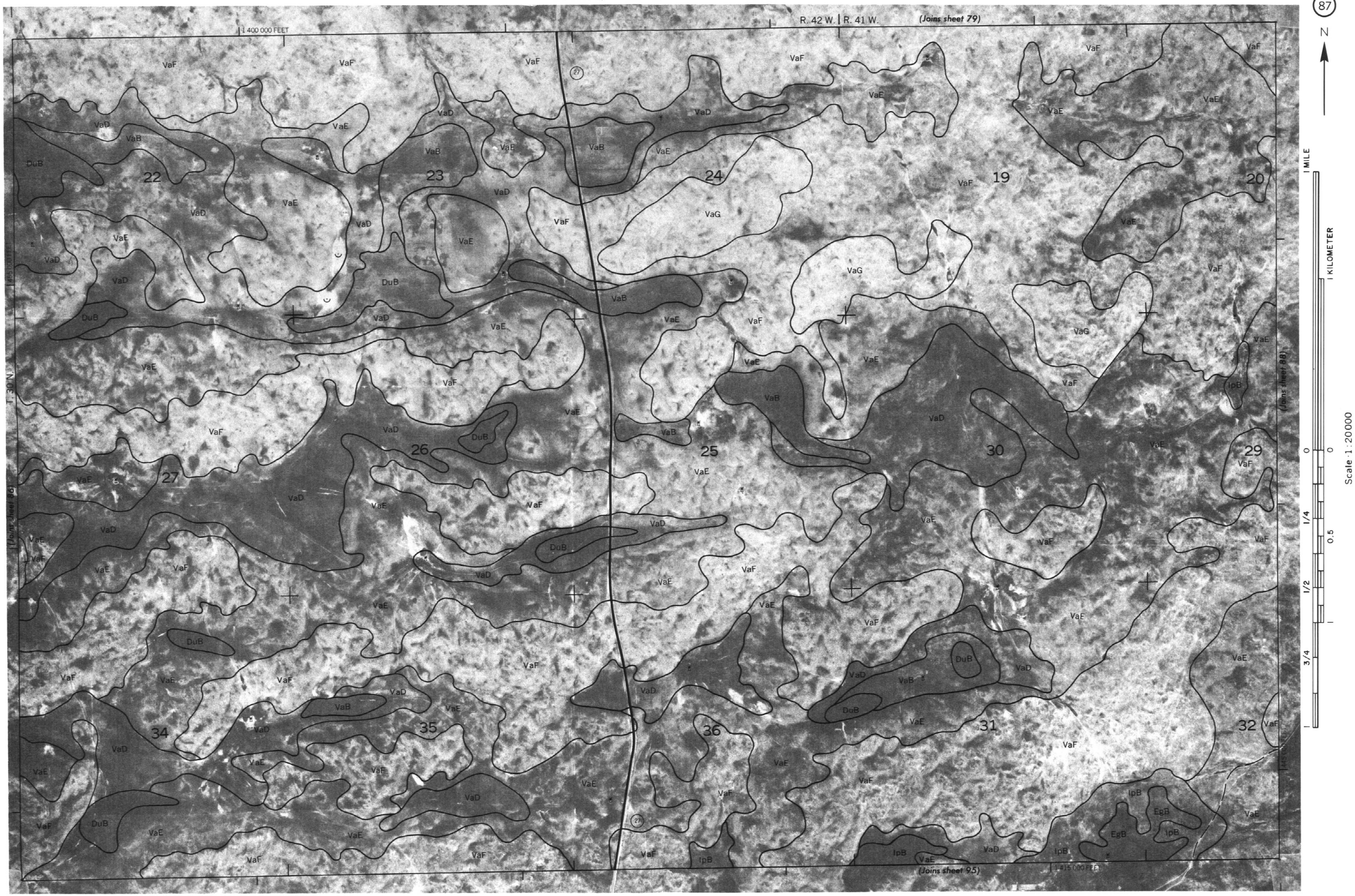
0 1/4 1/2 3/4

0 0.5 1



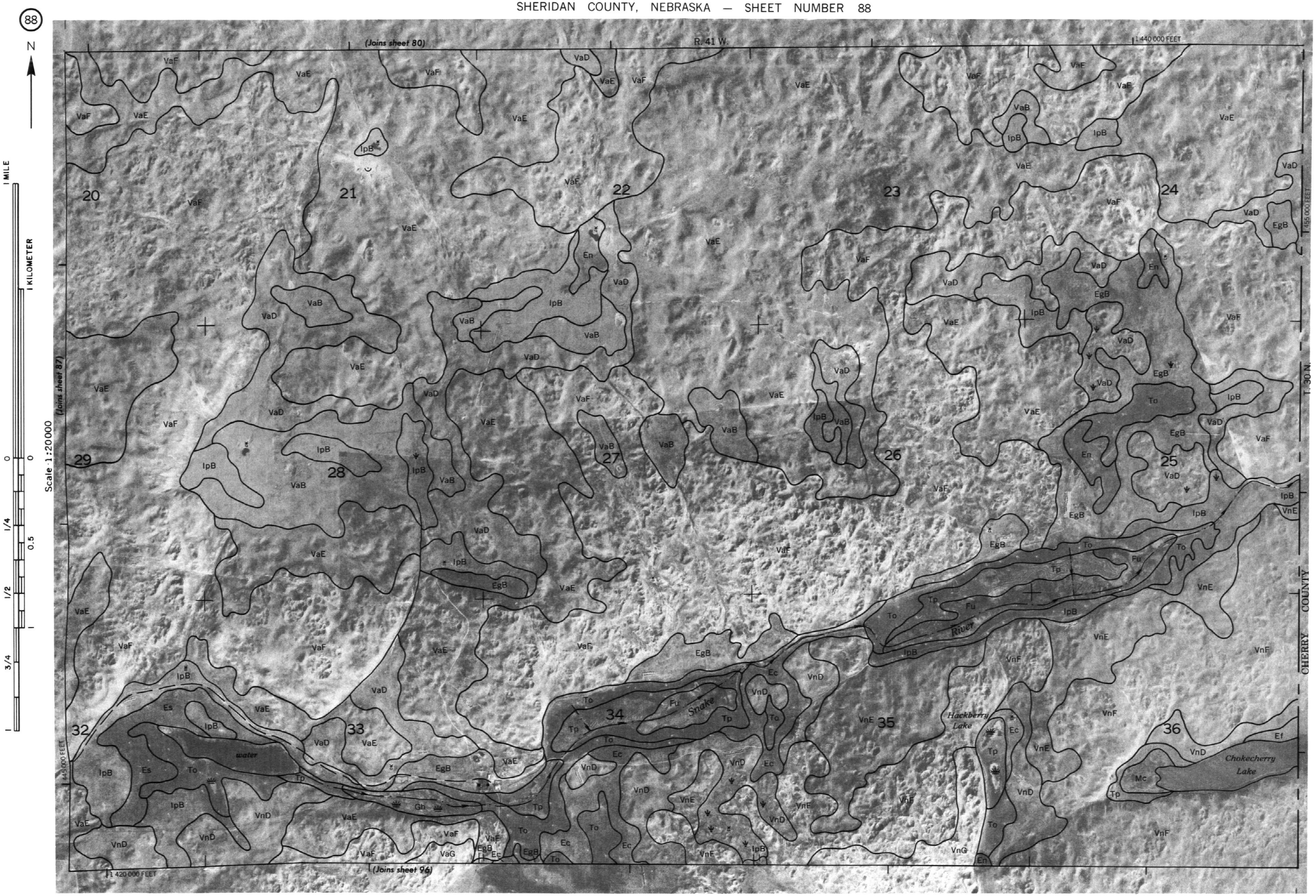
SHERIDAN COUNTY, NEBRASKA NO. 86

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



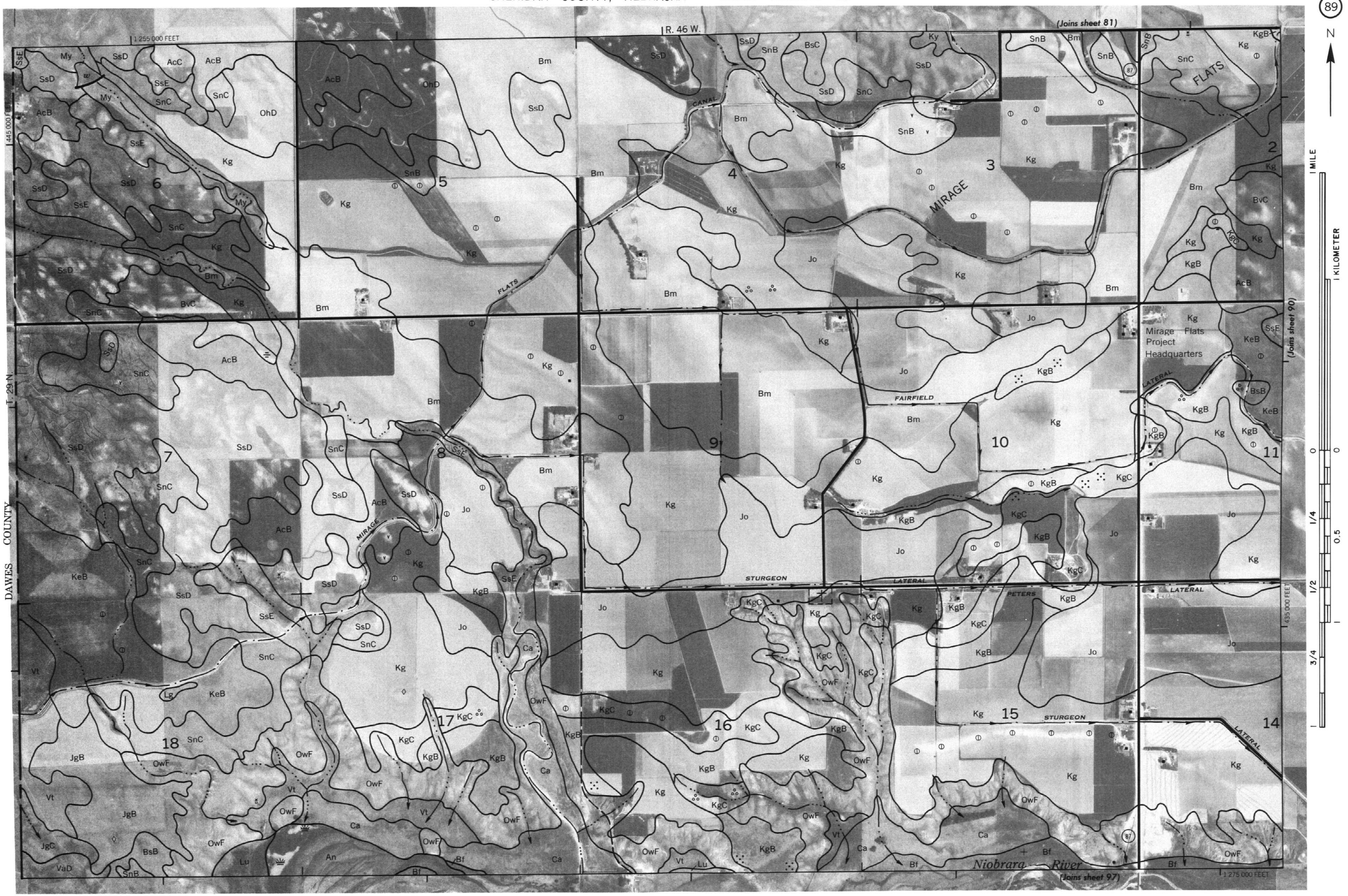
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 87



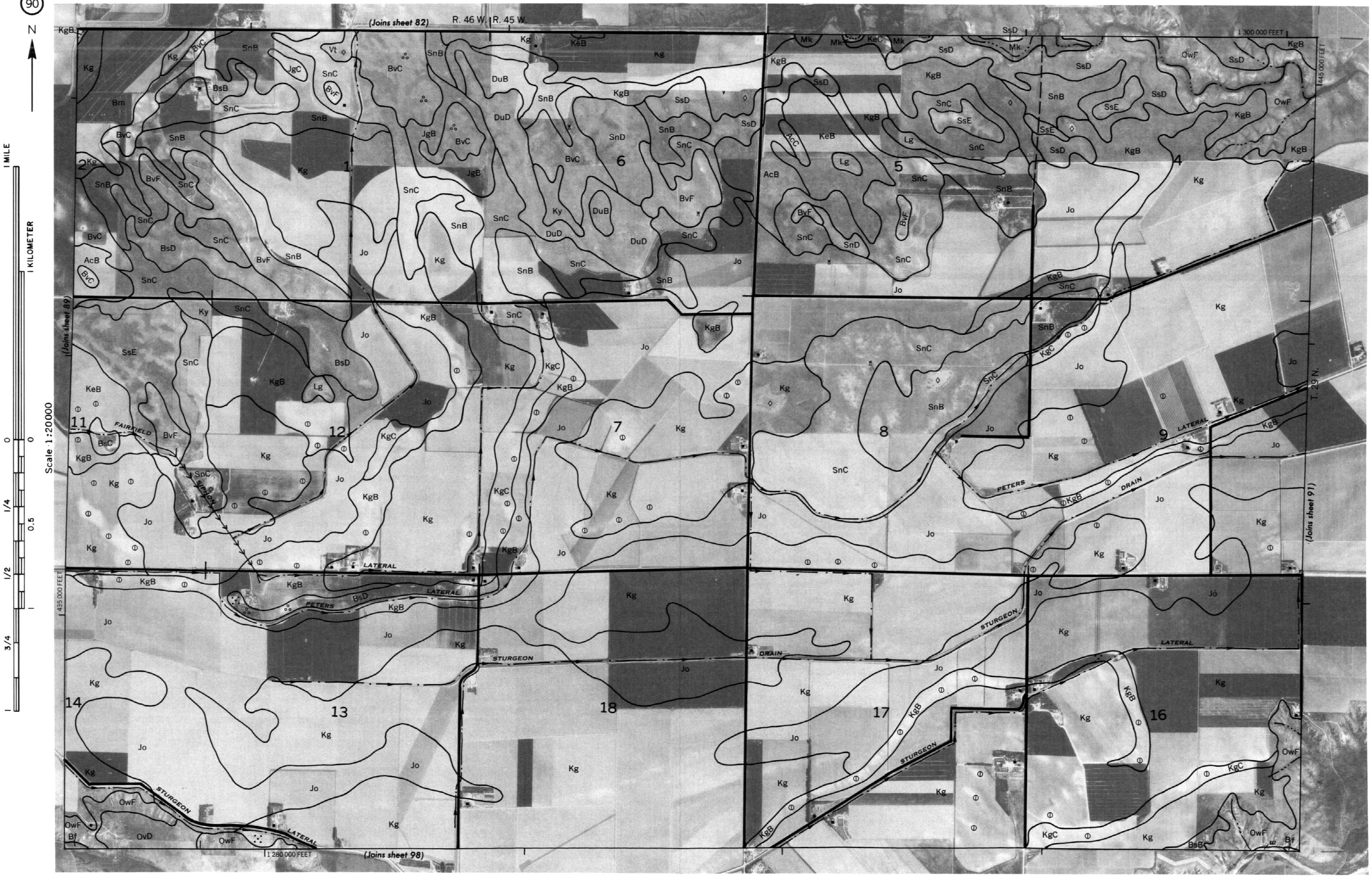
SHERIDAN COUNTY, NEBRASKA NO. 88

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

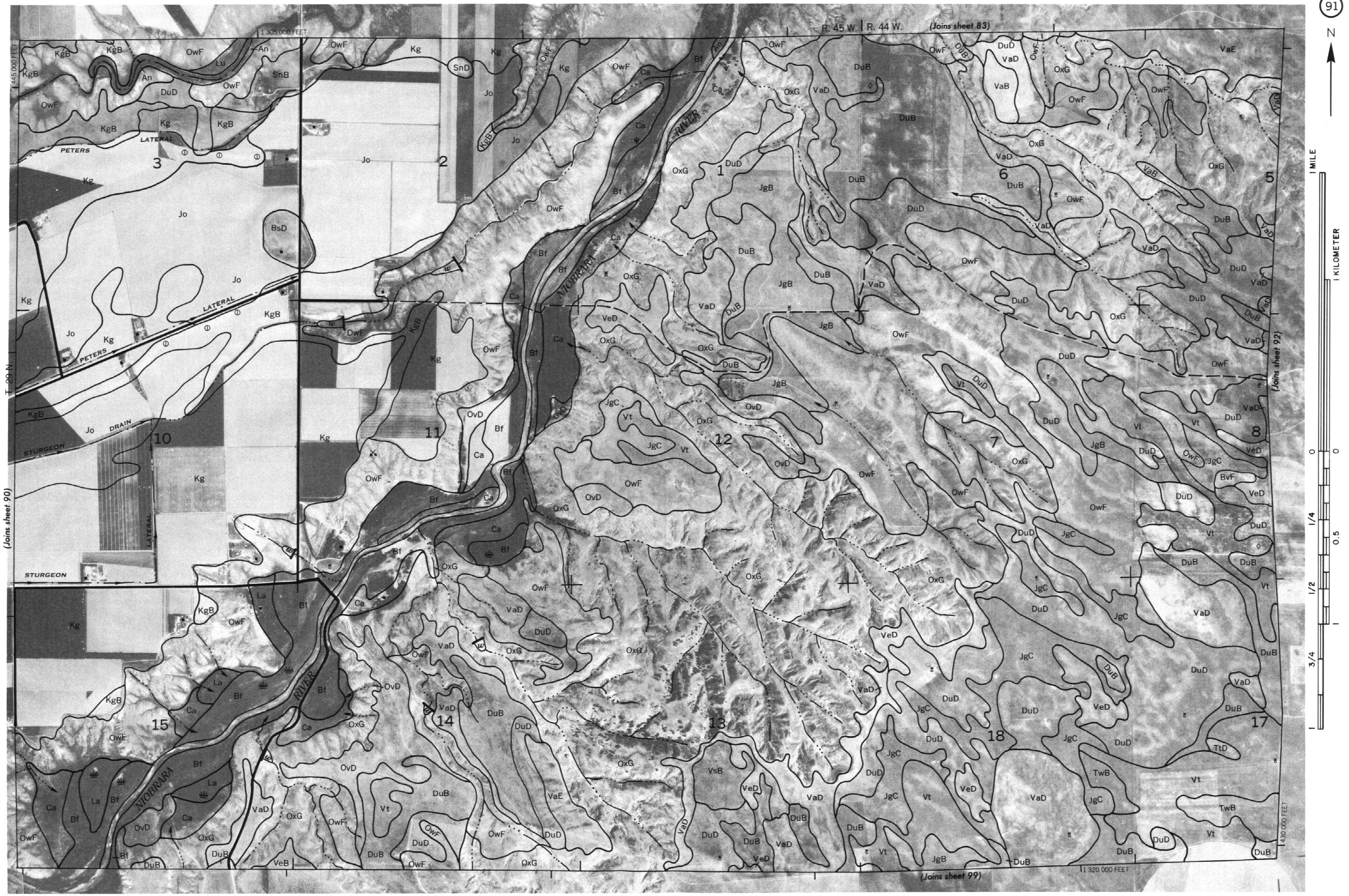
SHERIDAN COUNTY, NEBRASKA NO. 89



SHERIDAN COUNTY, NEBRASKA NO. 90

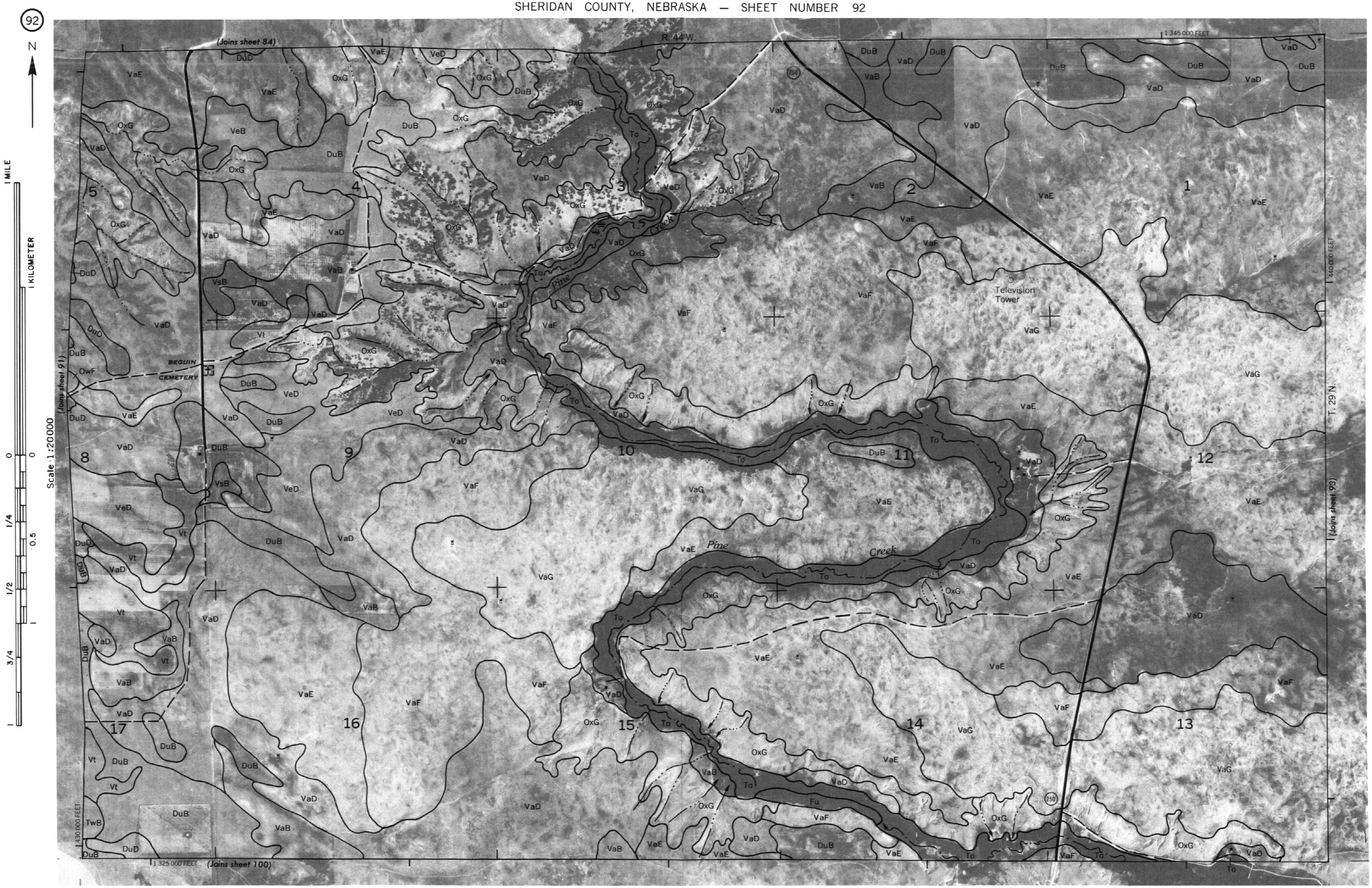
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(91)



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

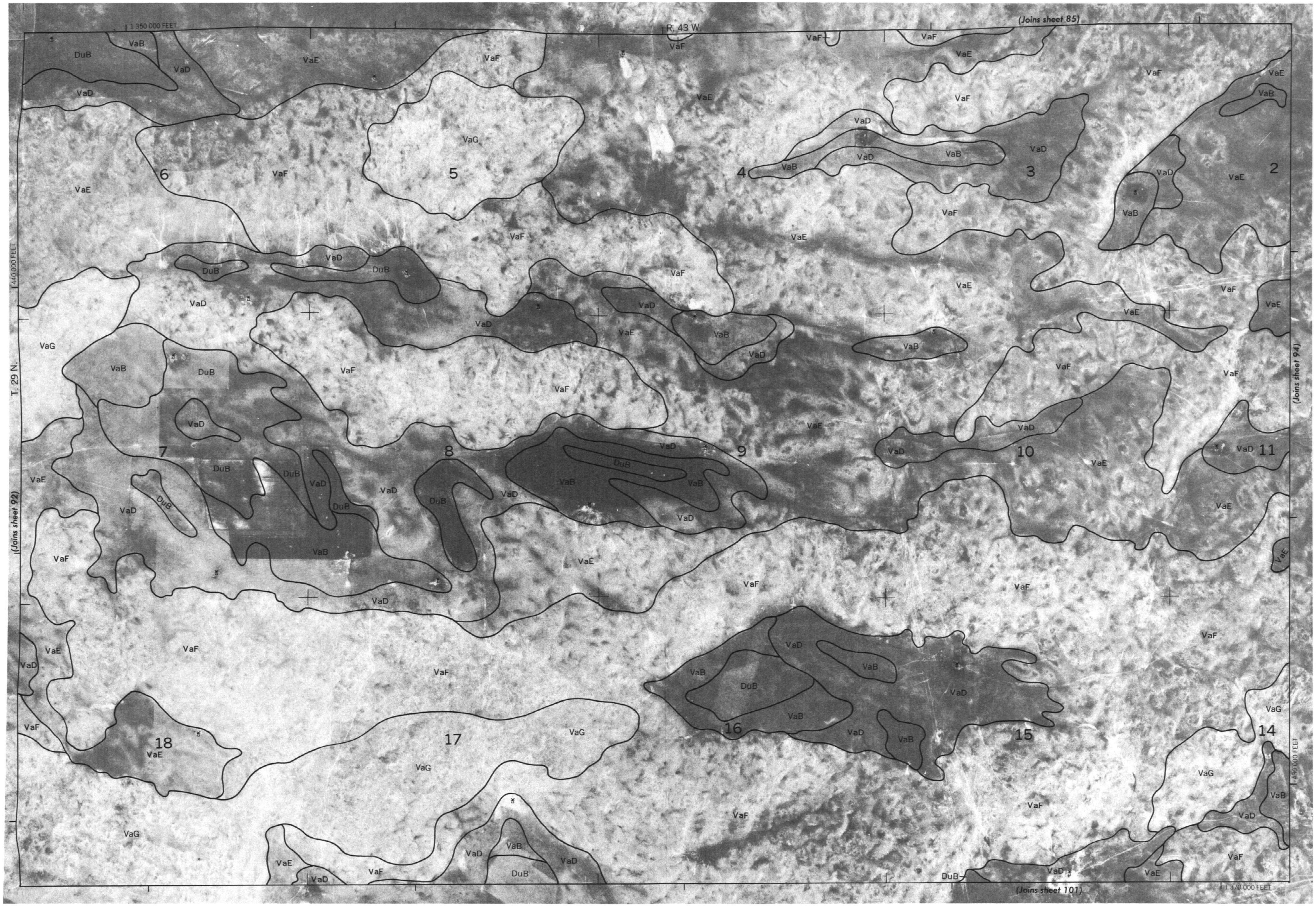
SHERIDAN COUNTY, NEBRASKA NO. 91



SHERIDAN COUNTY, NEBRASKA NO. 92

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

93



N

1 MILE

1 KILOMETER

0 1/4 1/2 3/4 1

0 0.5 1

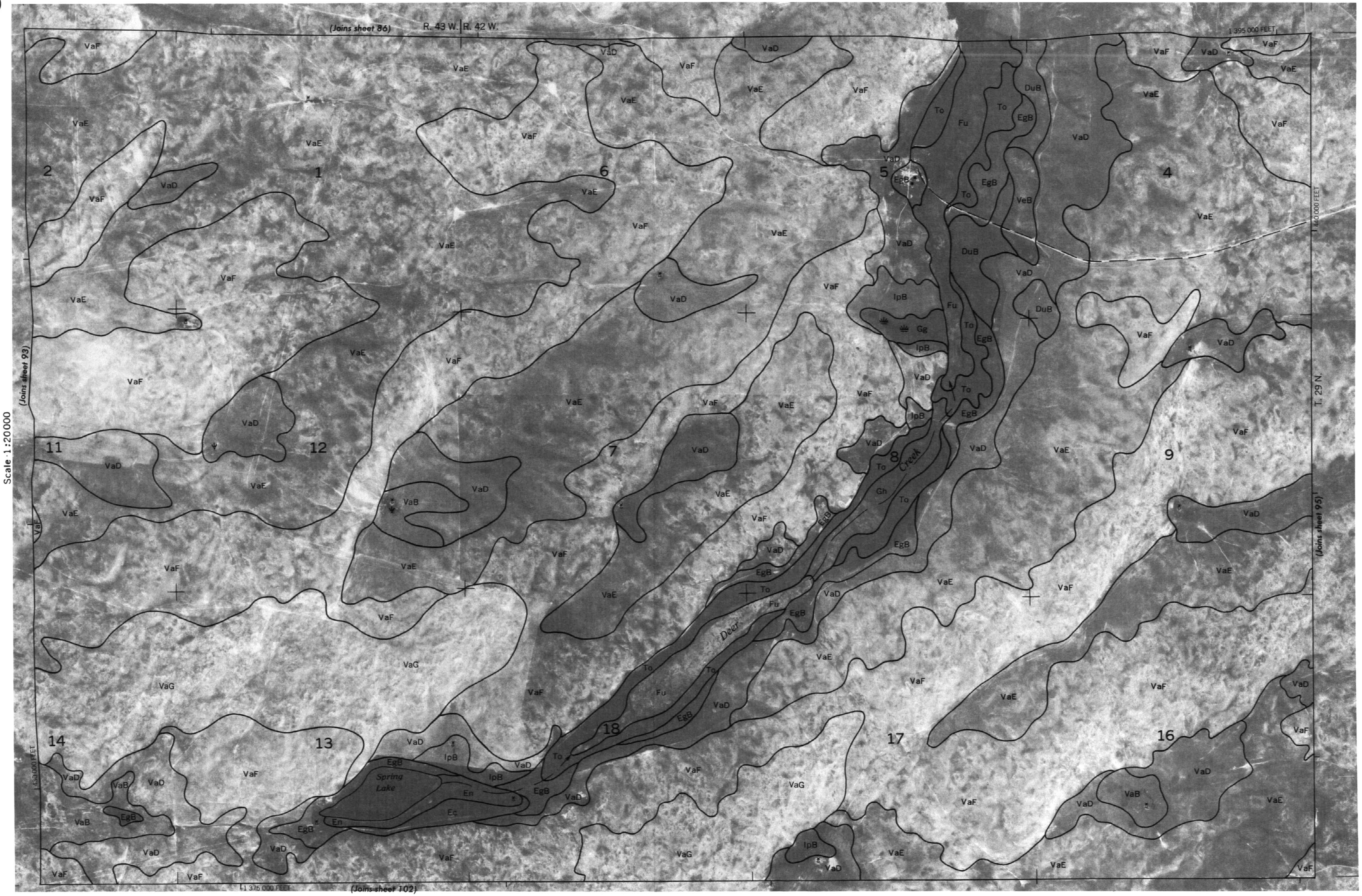
Scale 1:20000

SHERIDAN COUNTY, NEBRASKA NO. 93

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

94

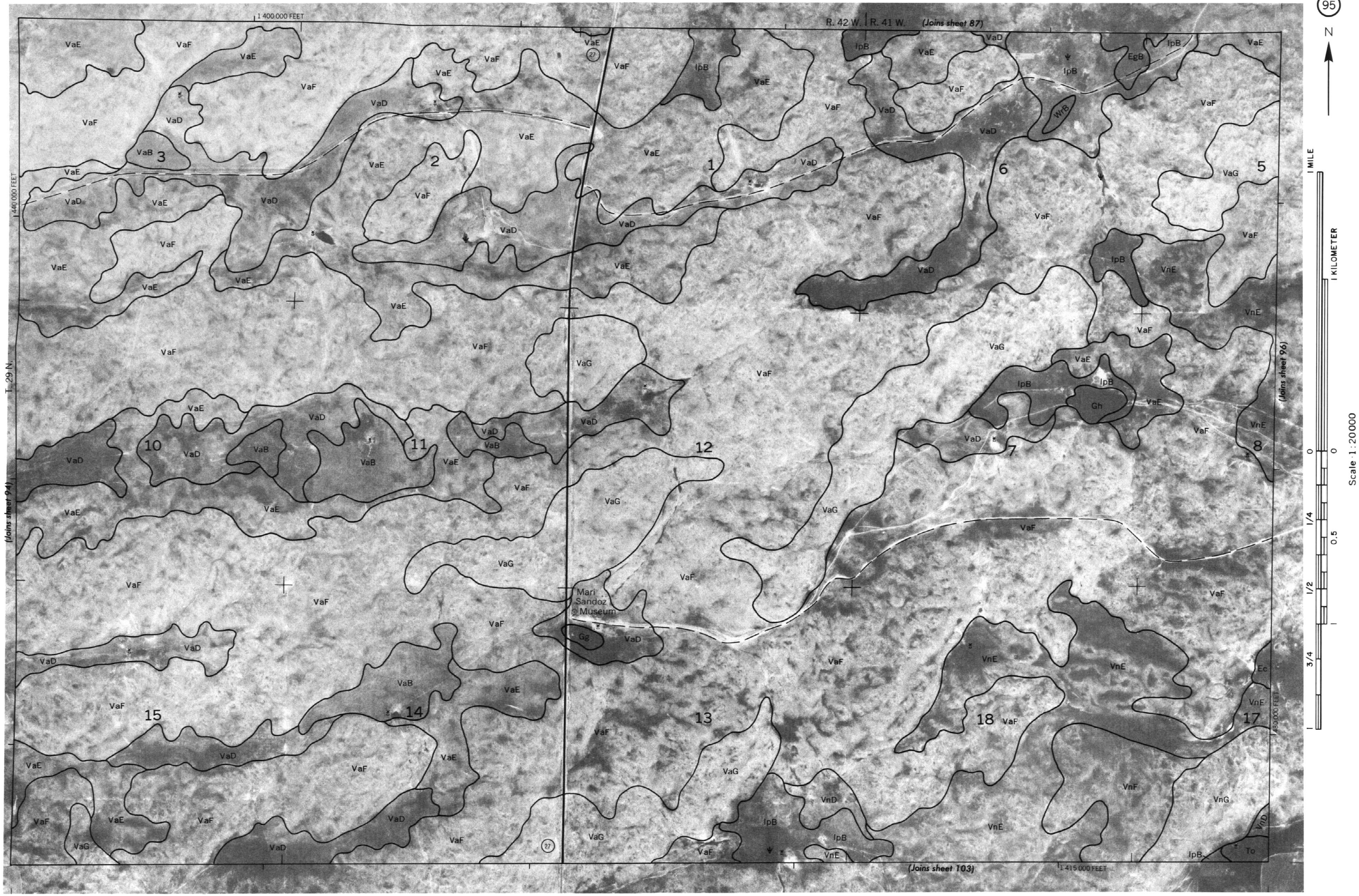
N



1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0
0.5
1
Scale 1:20000

SHERIDAN COUNTY, NEBRASKA NO. 94

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

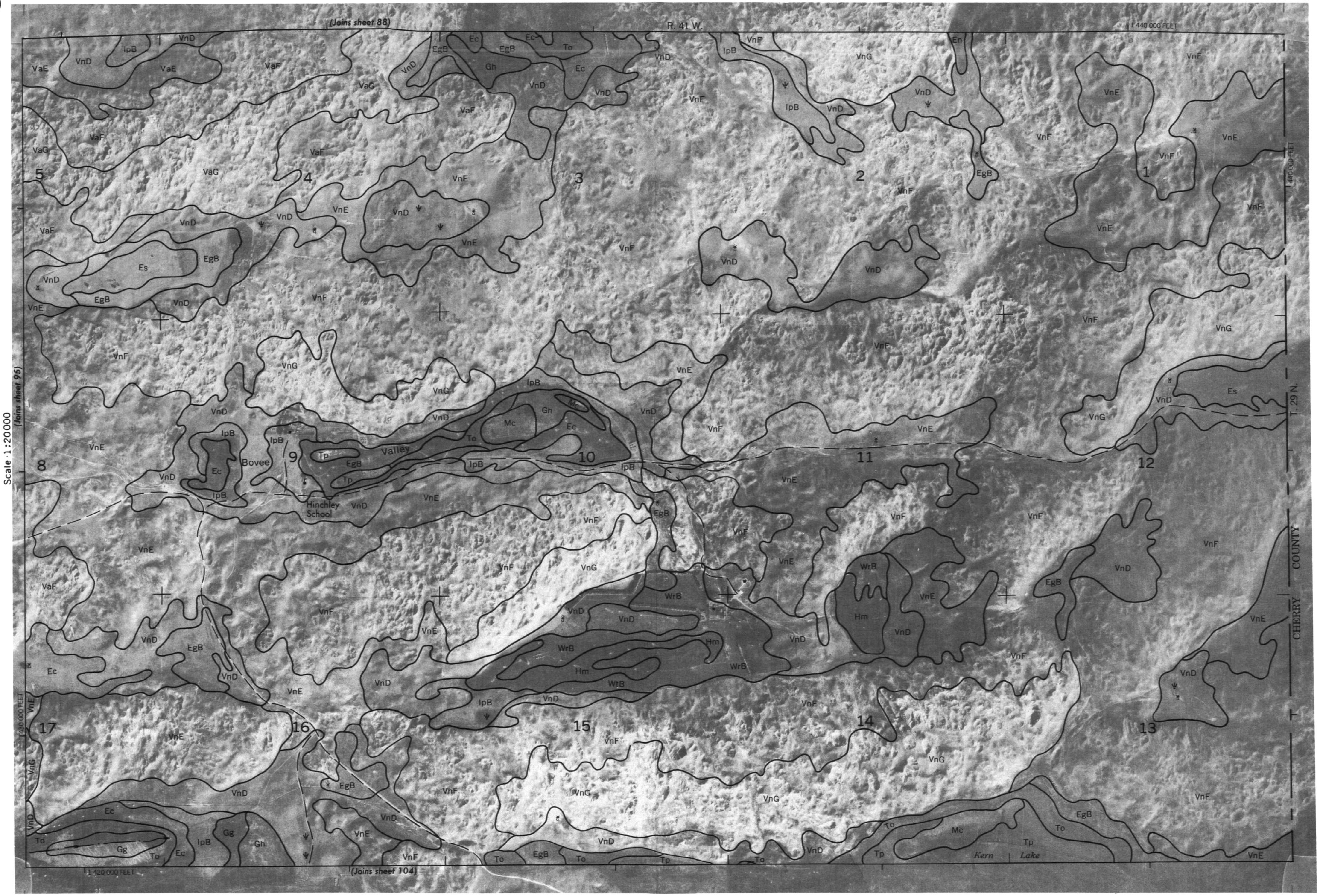


This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 95

96

N



1 MILE

1 KILOMETER

Scale 1:20000

0 1/4 1/2 3/4 1

0 0.5 1

SHERIDAN COUNTY, NEBRASKA NO. 96

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 97

SHERIDAN COUNTY, NEBRASKA — SHEET NUMBER 98

N

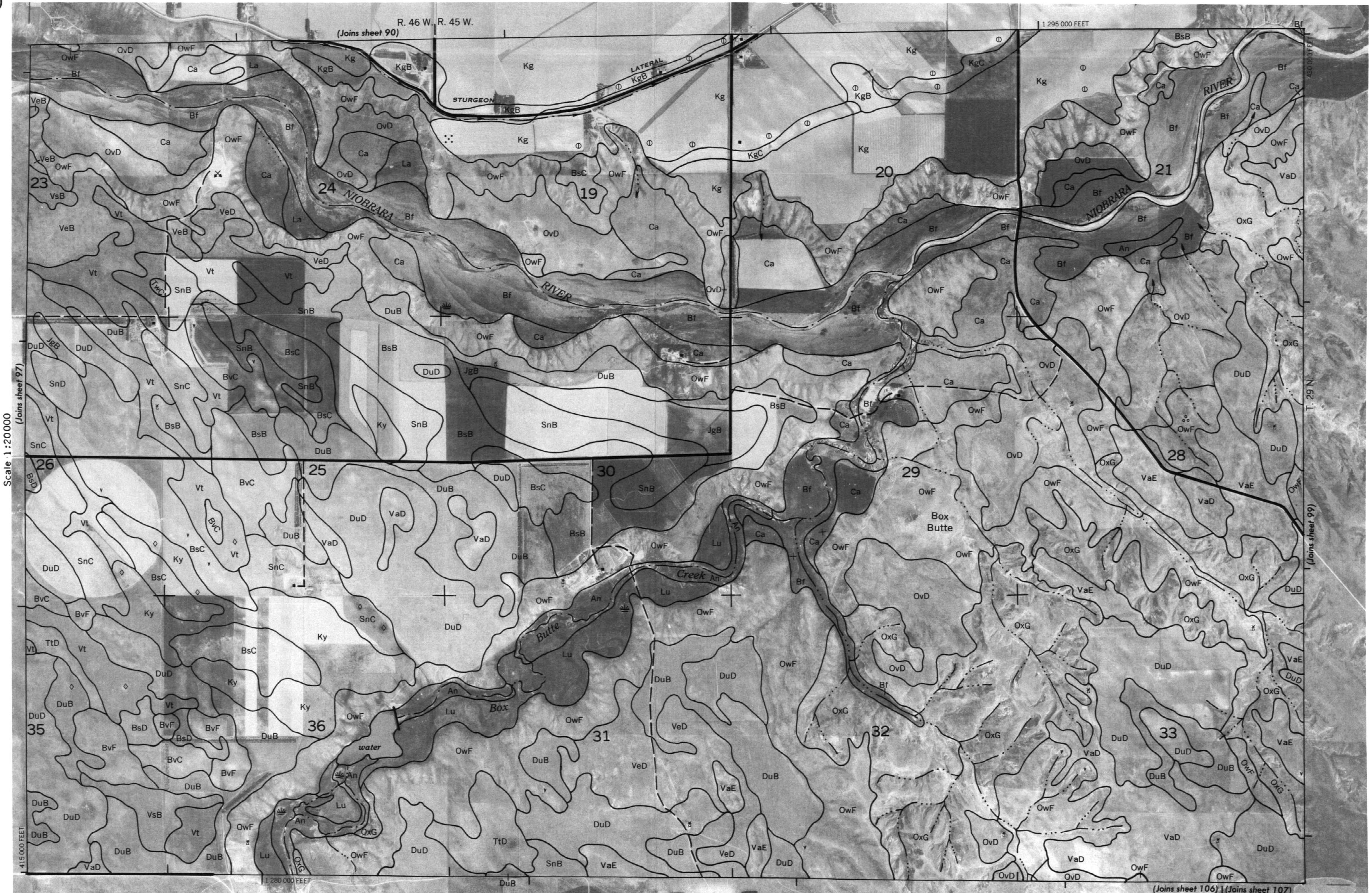
1 MILE

1 KILOMETER

Scale 1:20000

0 1/4 1/2 3/4 1

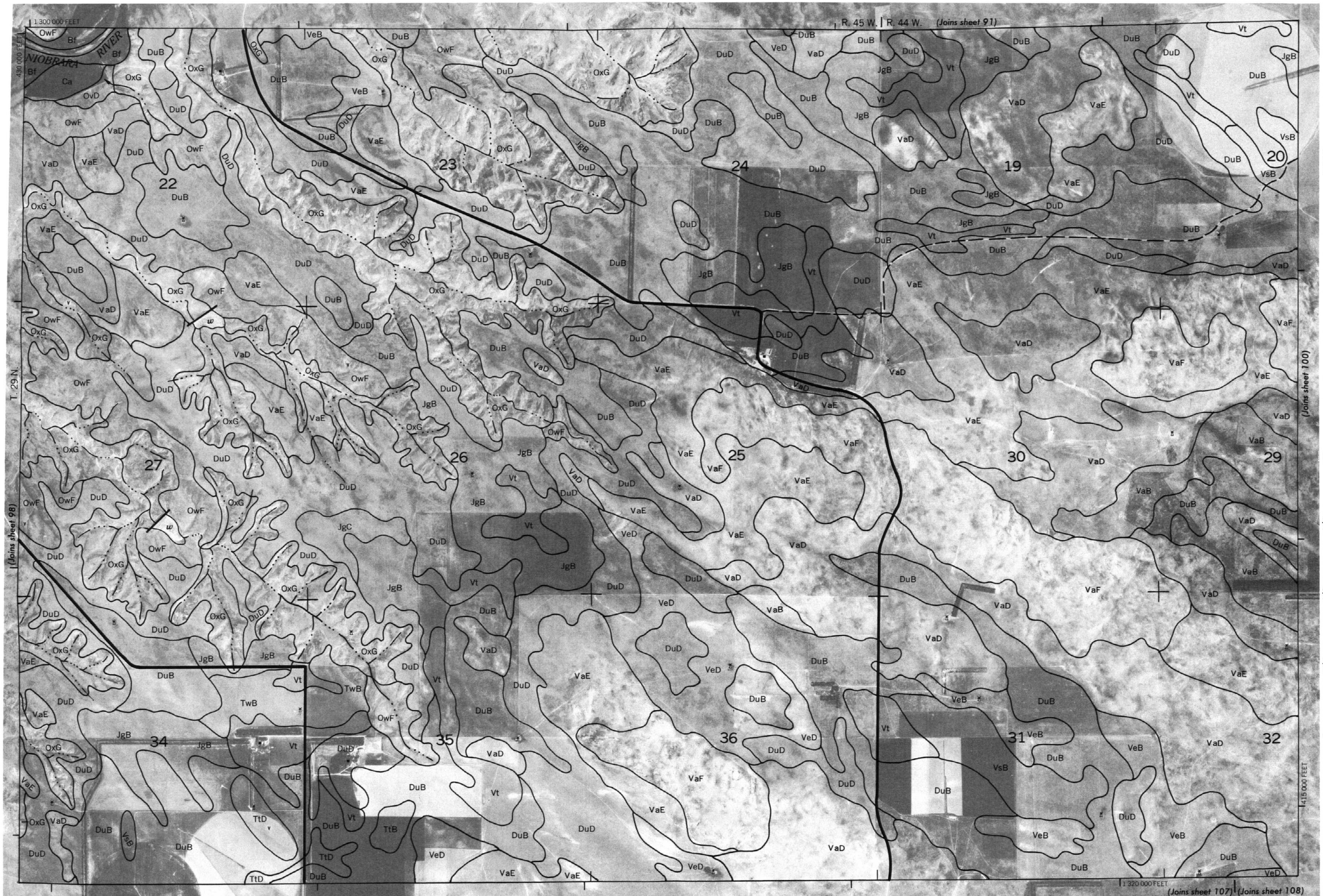
0 0.5 1



SHERIDAN COUNTY, NEBRASKA NO. 98

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

99



N

1 MILE

1 KILOMETER

0 1/4 1/2 3/4

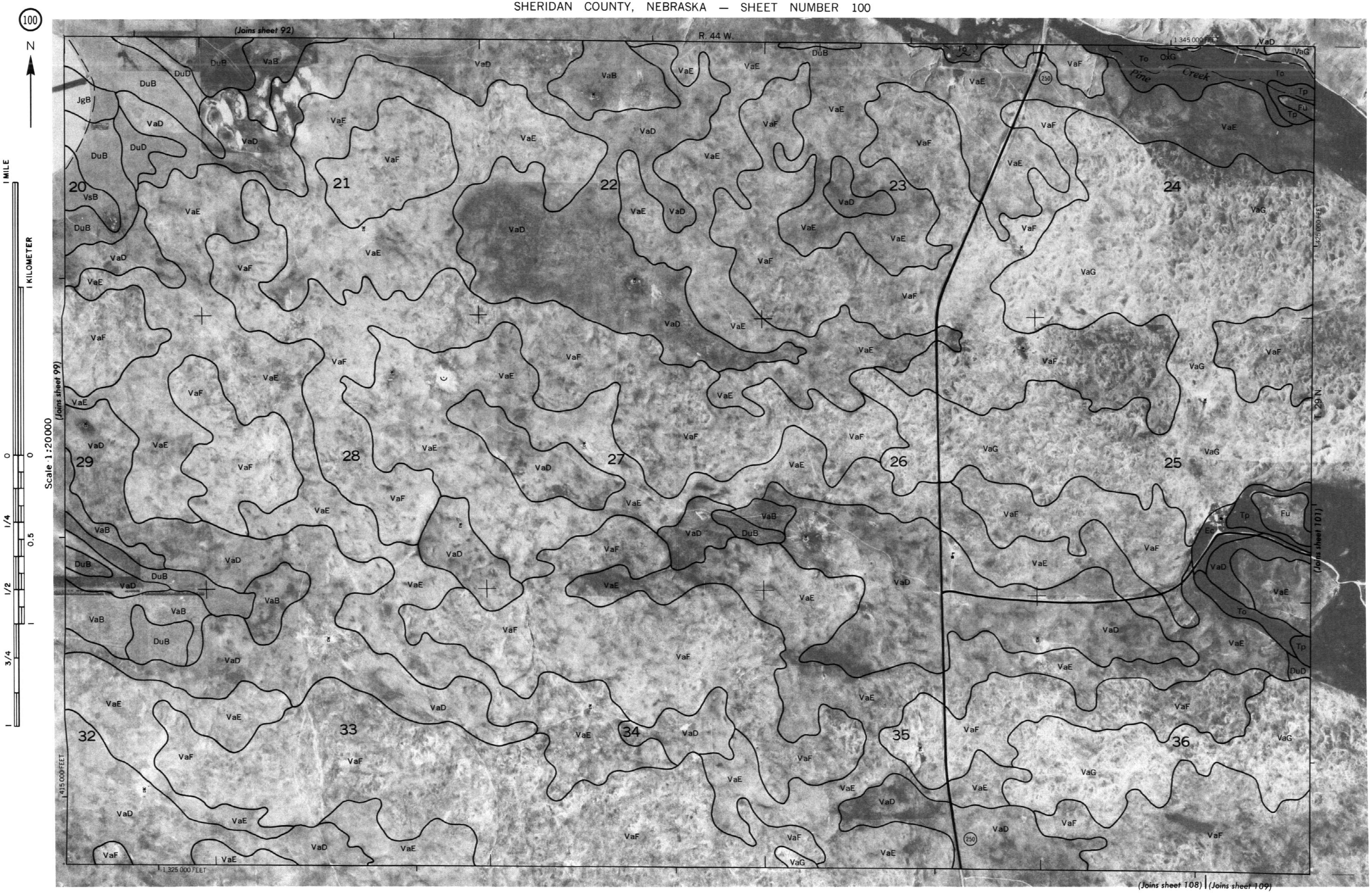
0 0.5

Scale 1:20000

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

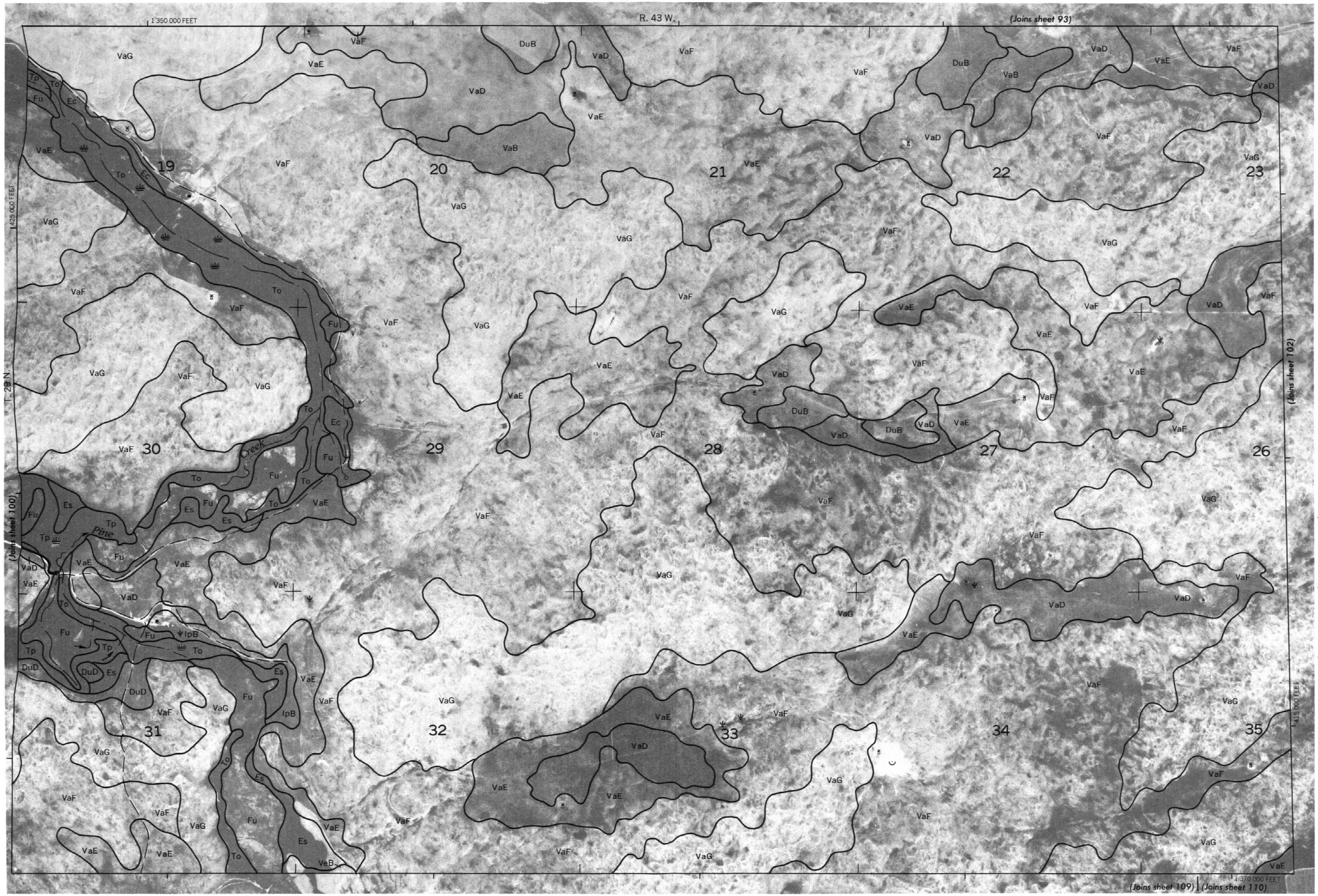
SHERIDAN COUNTY, NEBRASKA NO. 99

100



SHERIDAN COUNTY, NEBRASKA NO. 100

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



101

N

1 MILE

1 KILOMETER

0 1/4 1/2 3/4

0 0.5

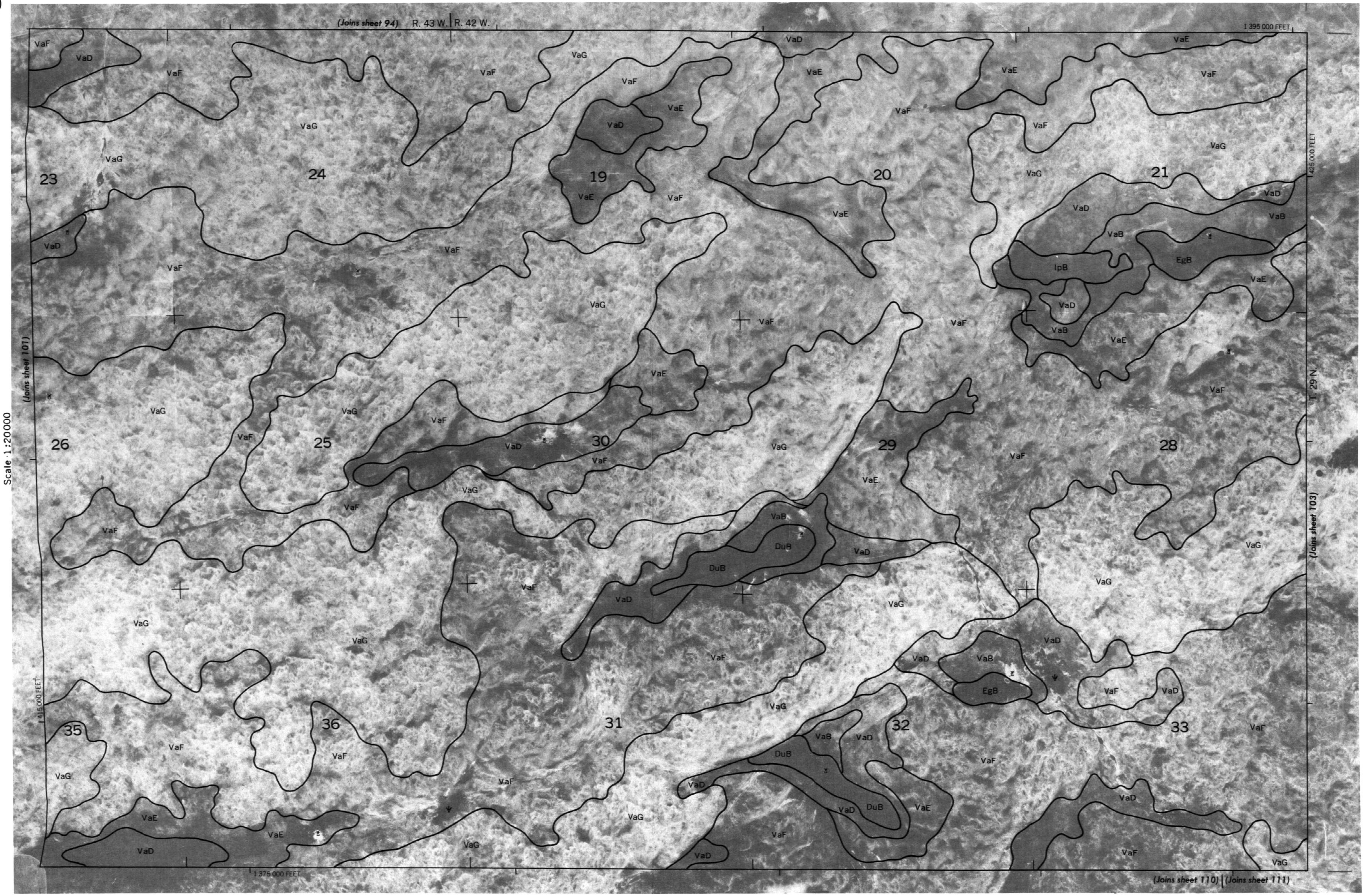
Scale 1:20000

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 101

102

N



1 MILE

1/4

1/2

3/4

1

0

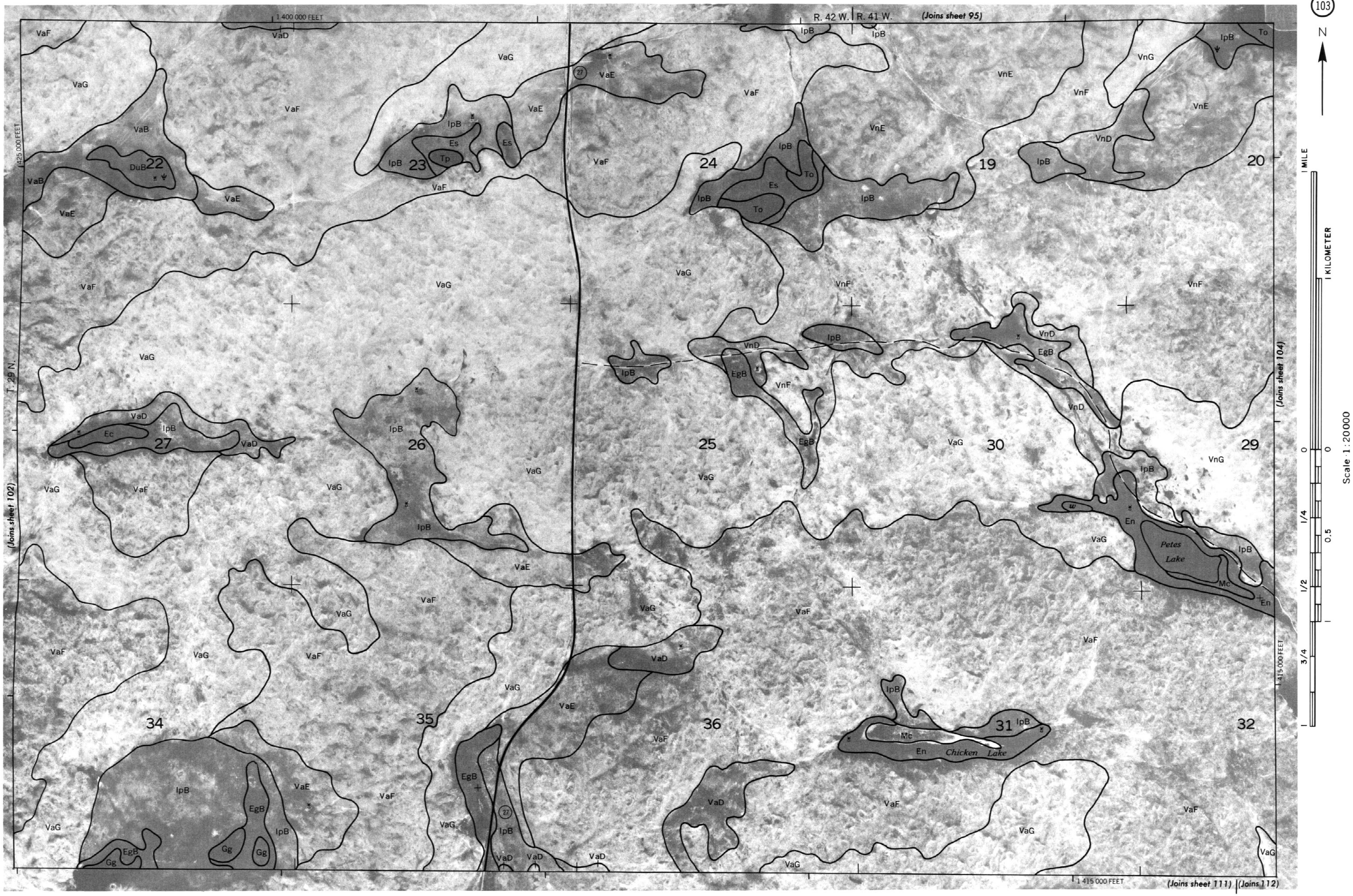
1 KILOMETER

0.5

Scale 1:20000

SHERIDAN COUNTY, NEBRASKA NO. 102

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

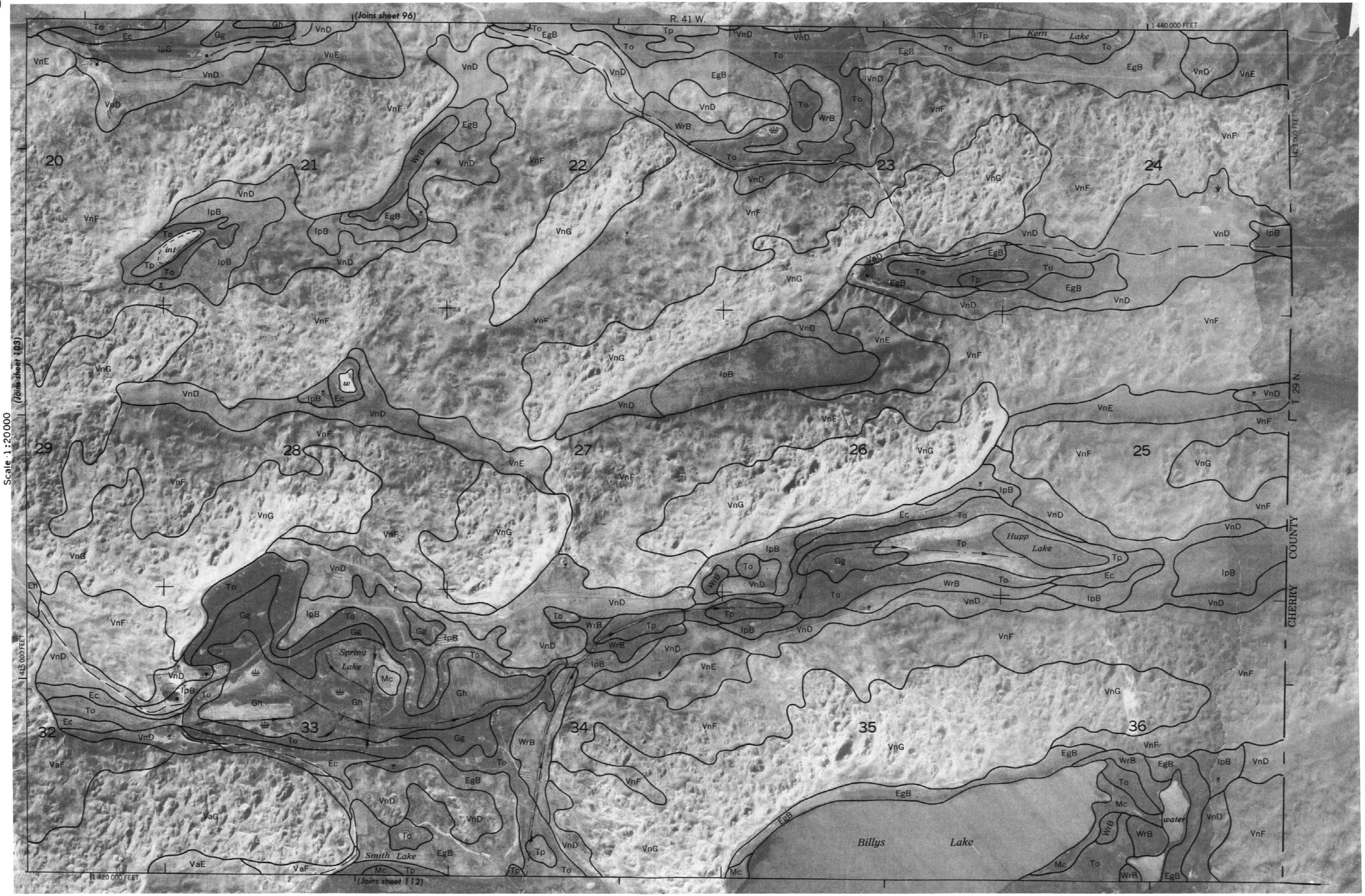


This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 103

104

N



Scale 1:20000

1 MILE: 0, 1/4, 1/2, 3/4, 1

1 KILOMETER: 0, 0.5, 1

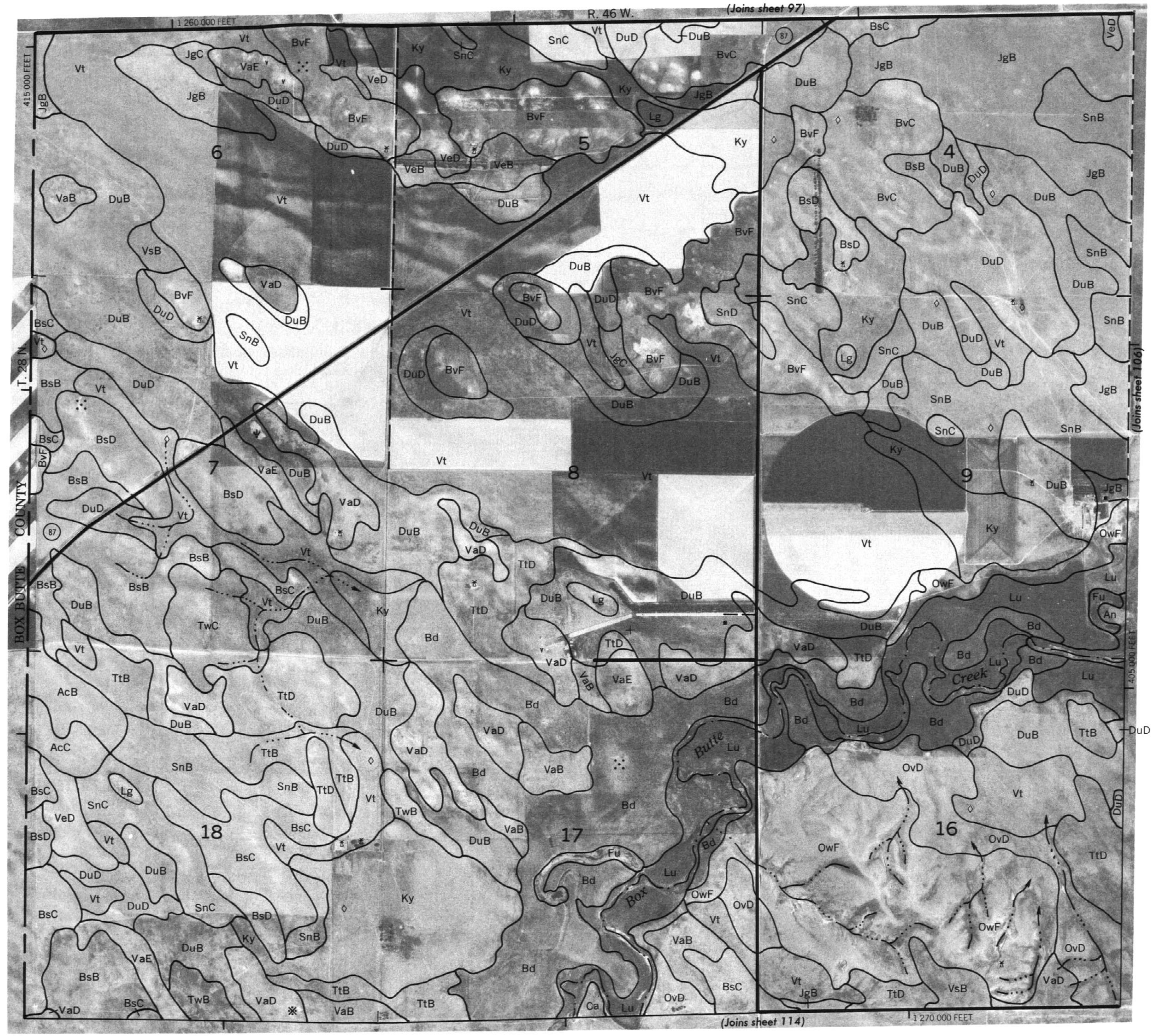
SHERIDAN COUNTY, NEBRASKA NO. 104

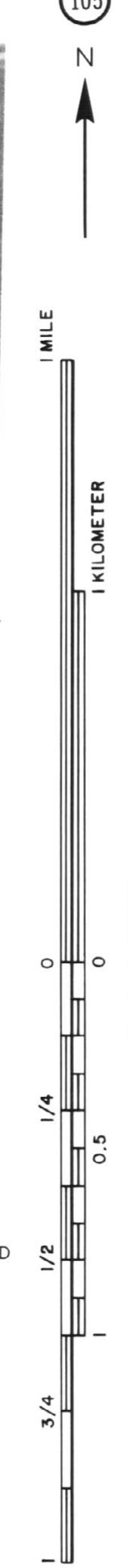
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 105

2000 AND 5000-FOOT GRID TICKS



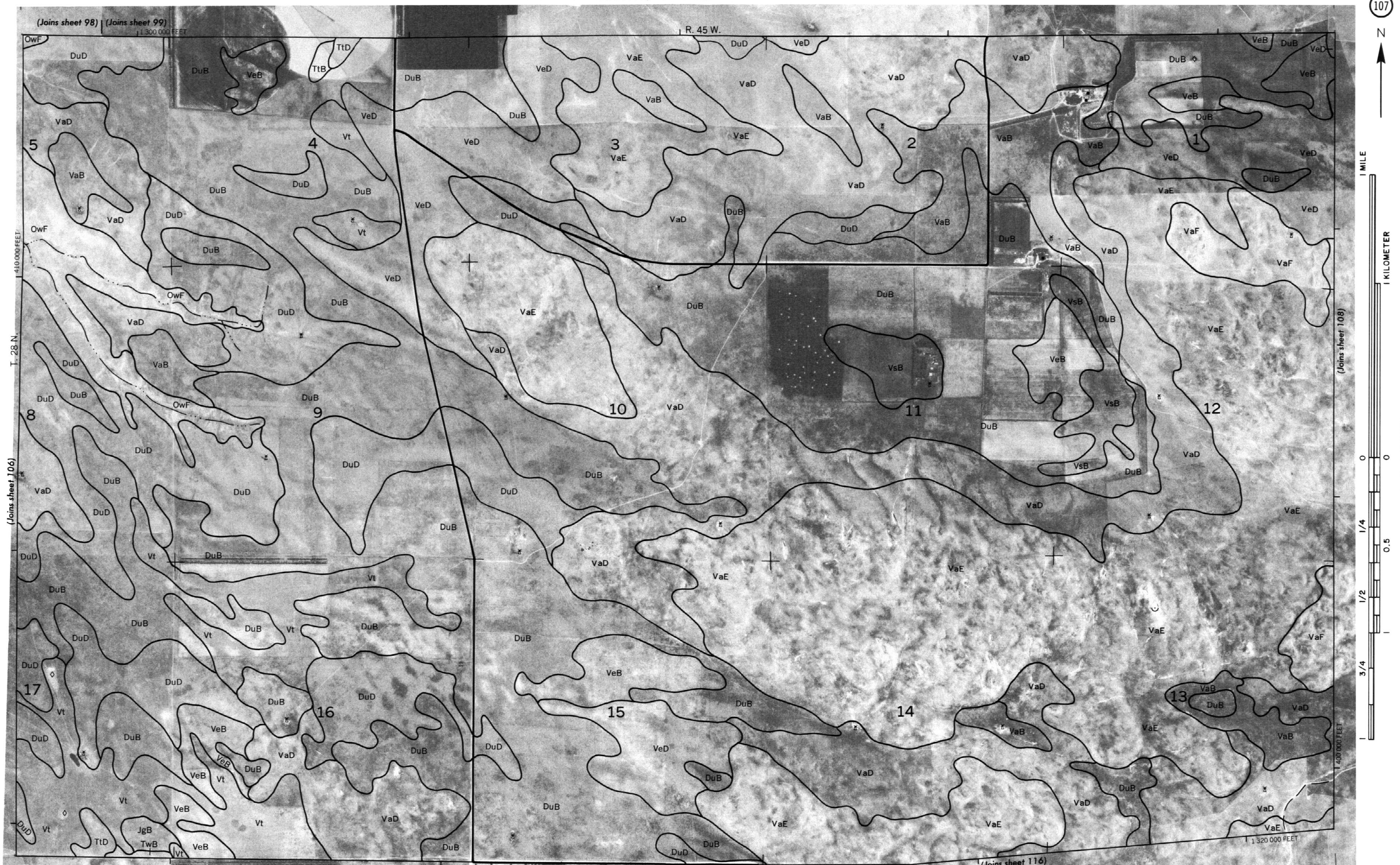


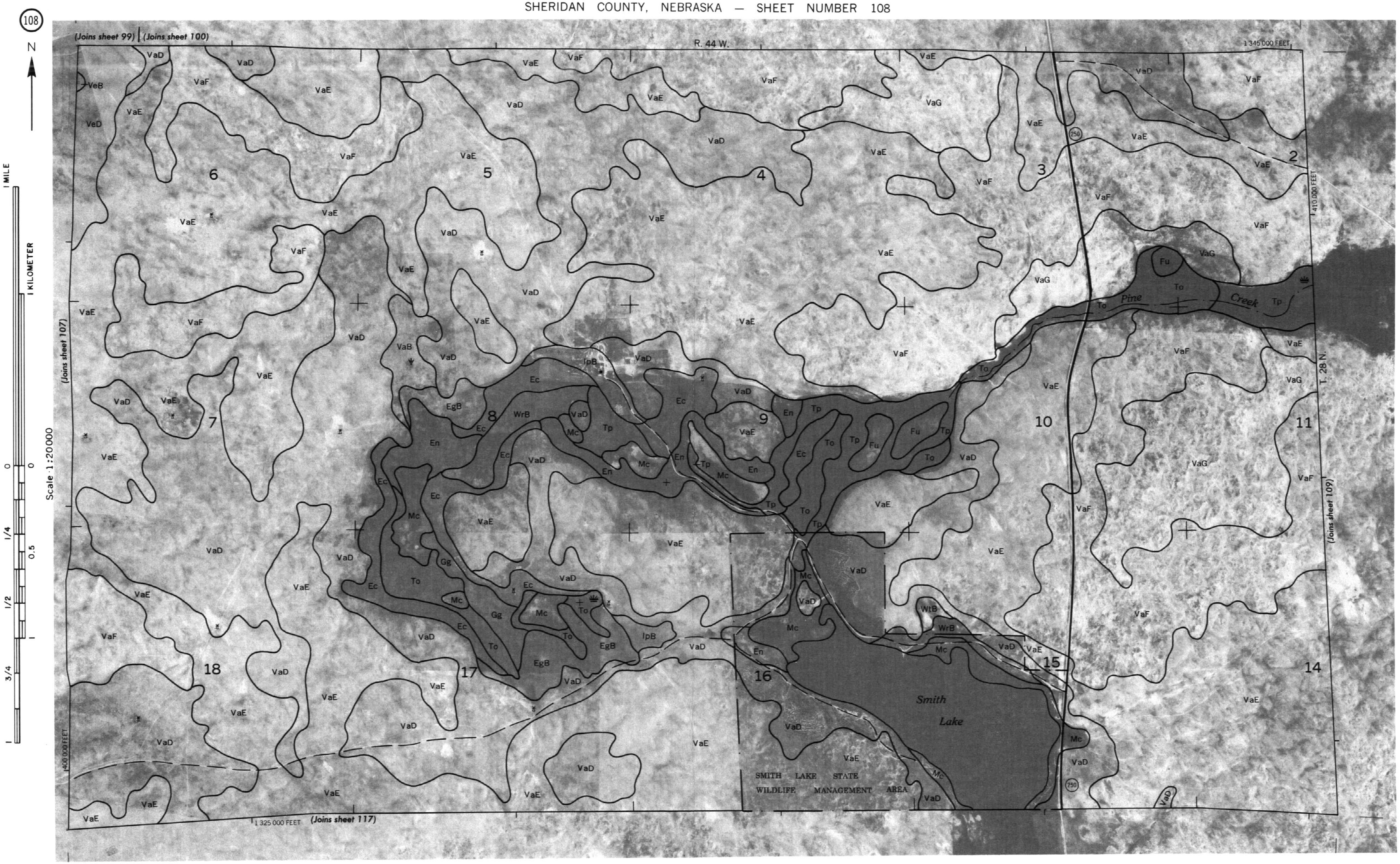
SHERIDAN COUNTY, NEBRASKA NO. 106

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 107



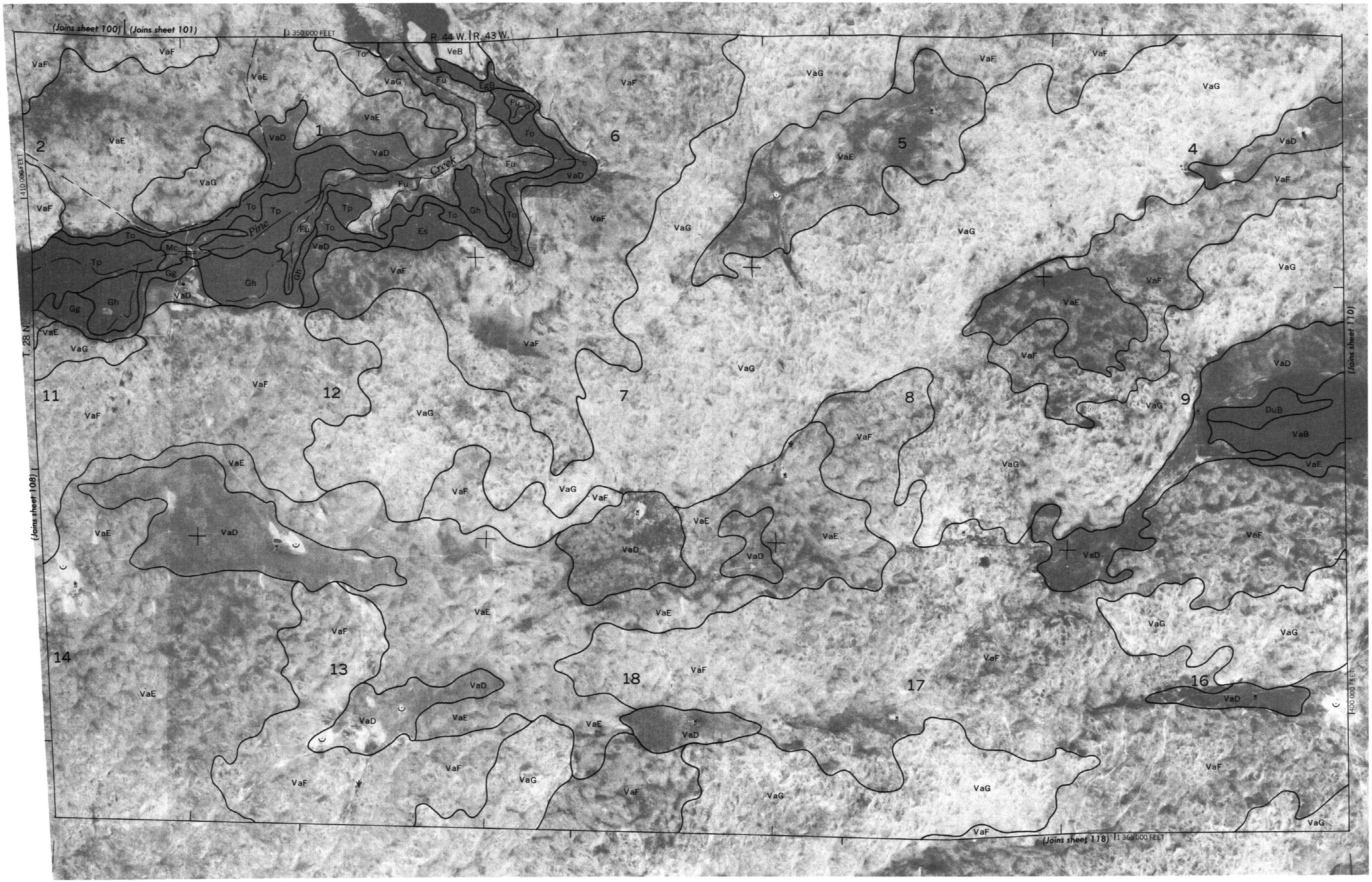


SHERIDAN COUNTY, NEBRASKA NO. 108

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 109



(109)

N

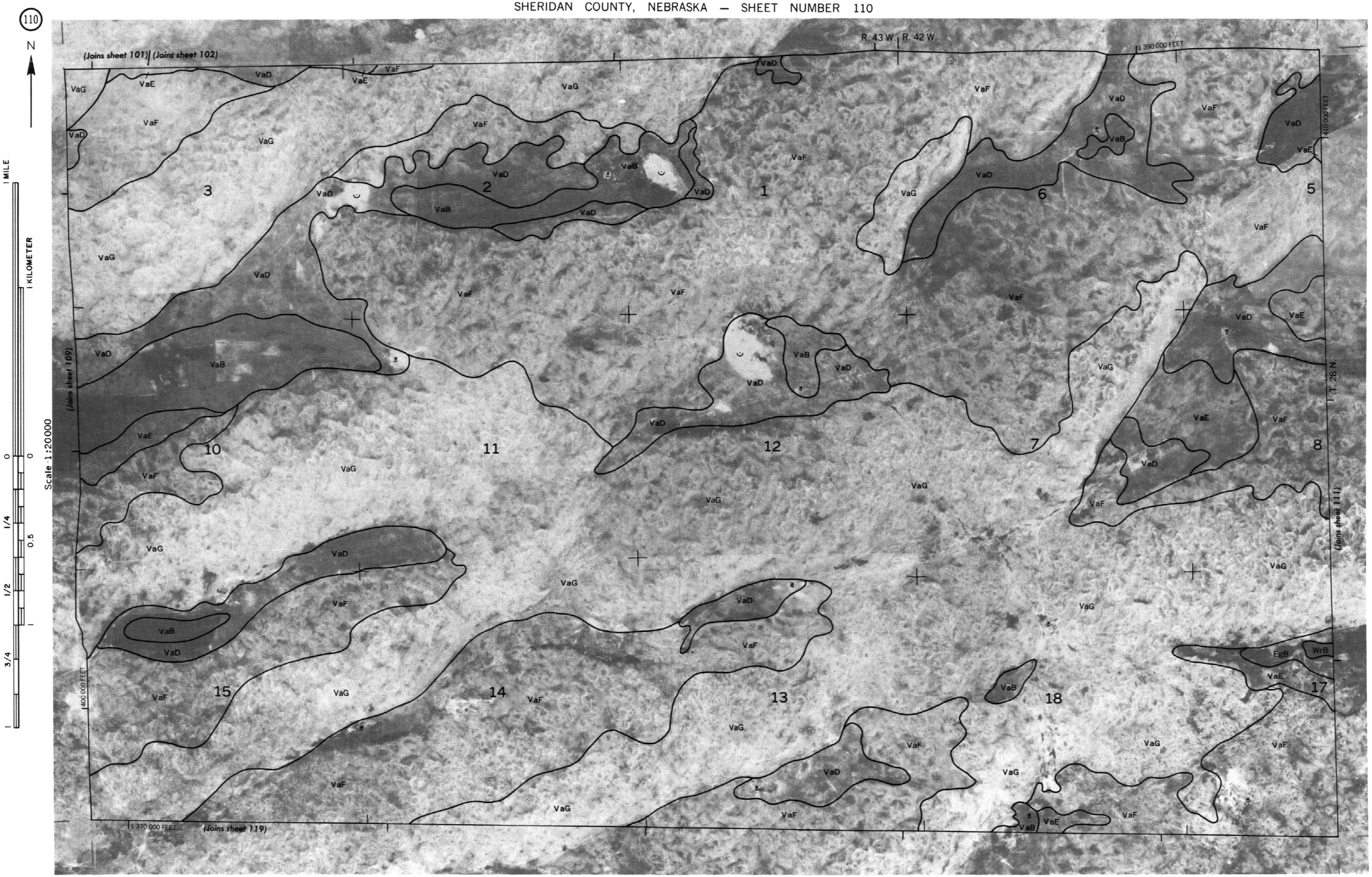
1 MILE

1 KILOMETER

0 1/4 1/2 3/4

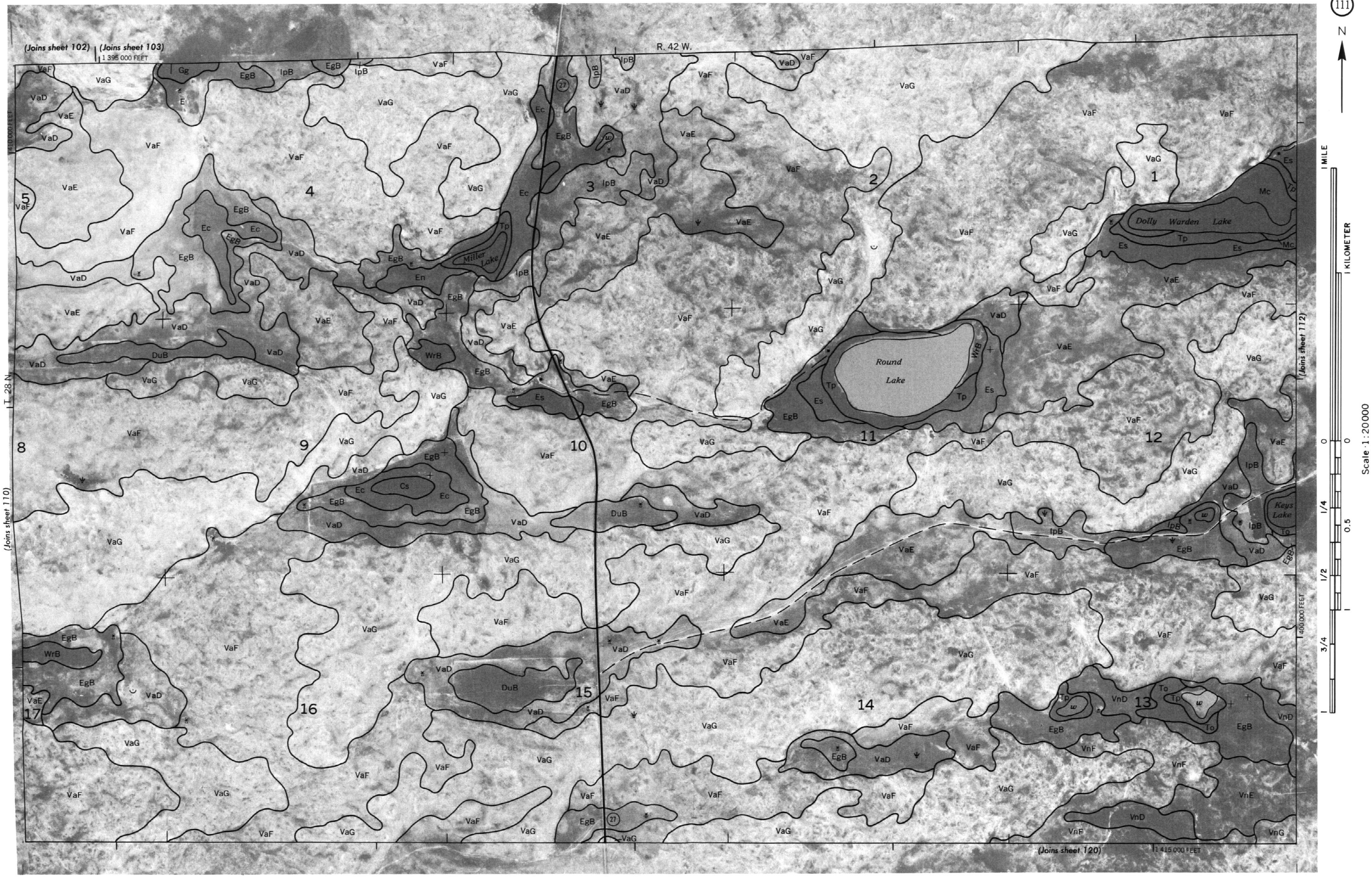
0 0.5

Scale 1:20000



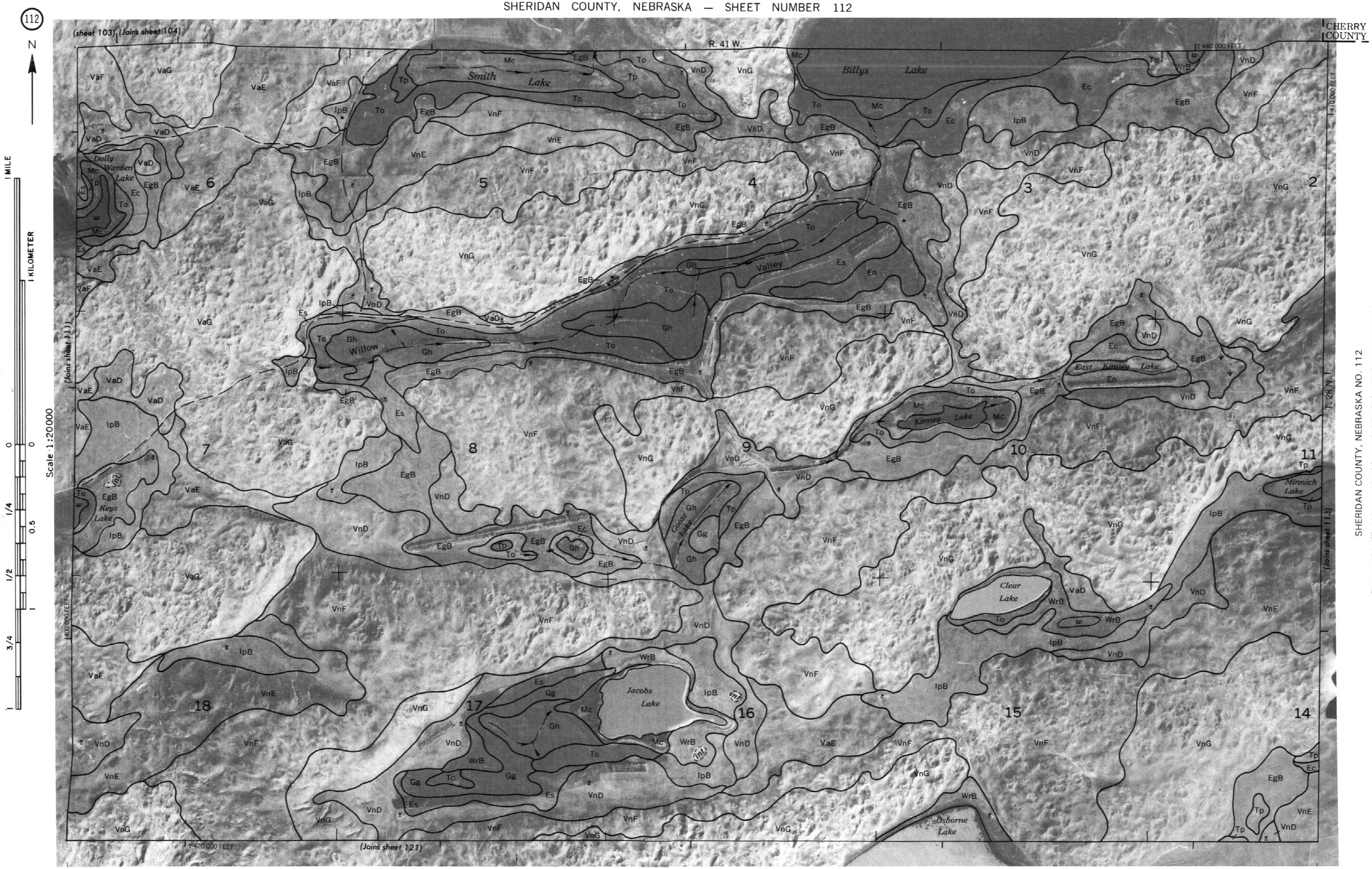
SHERIDAN COUNTY, NEBRASKA NO. 110

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



SHERIDAN COUNTY, NEBRASKA NO. 111

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

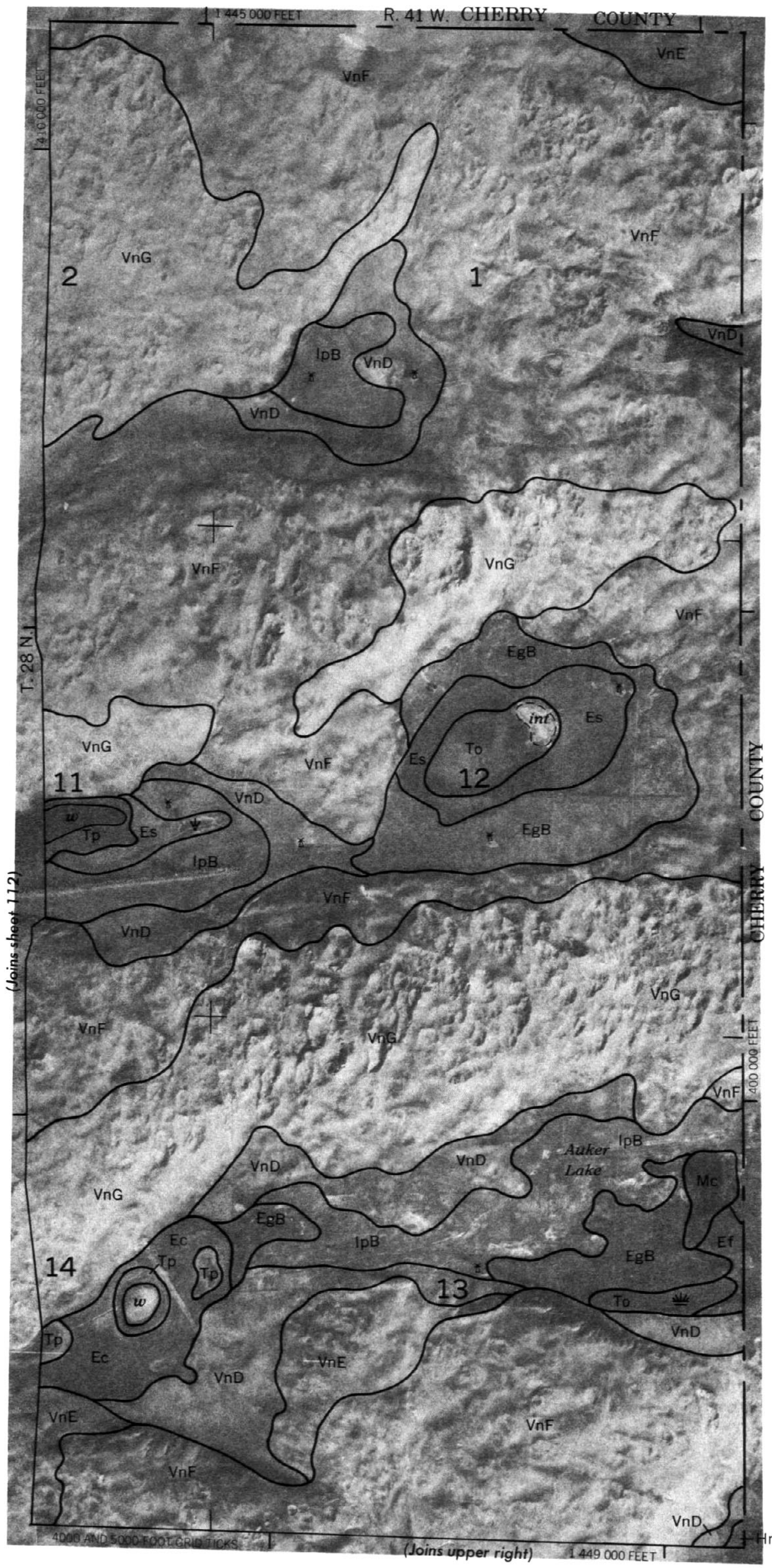


SHERIDAN COUNTY, NEBRASKA NO. 112

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 113



N

Scale 1:20000

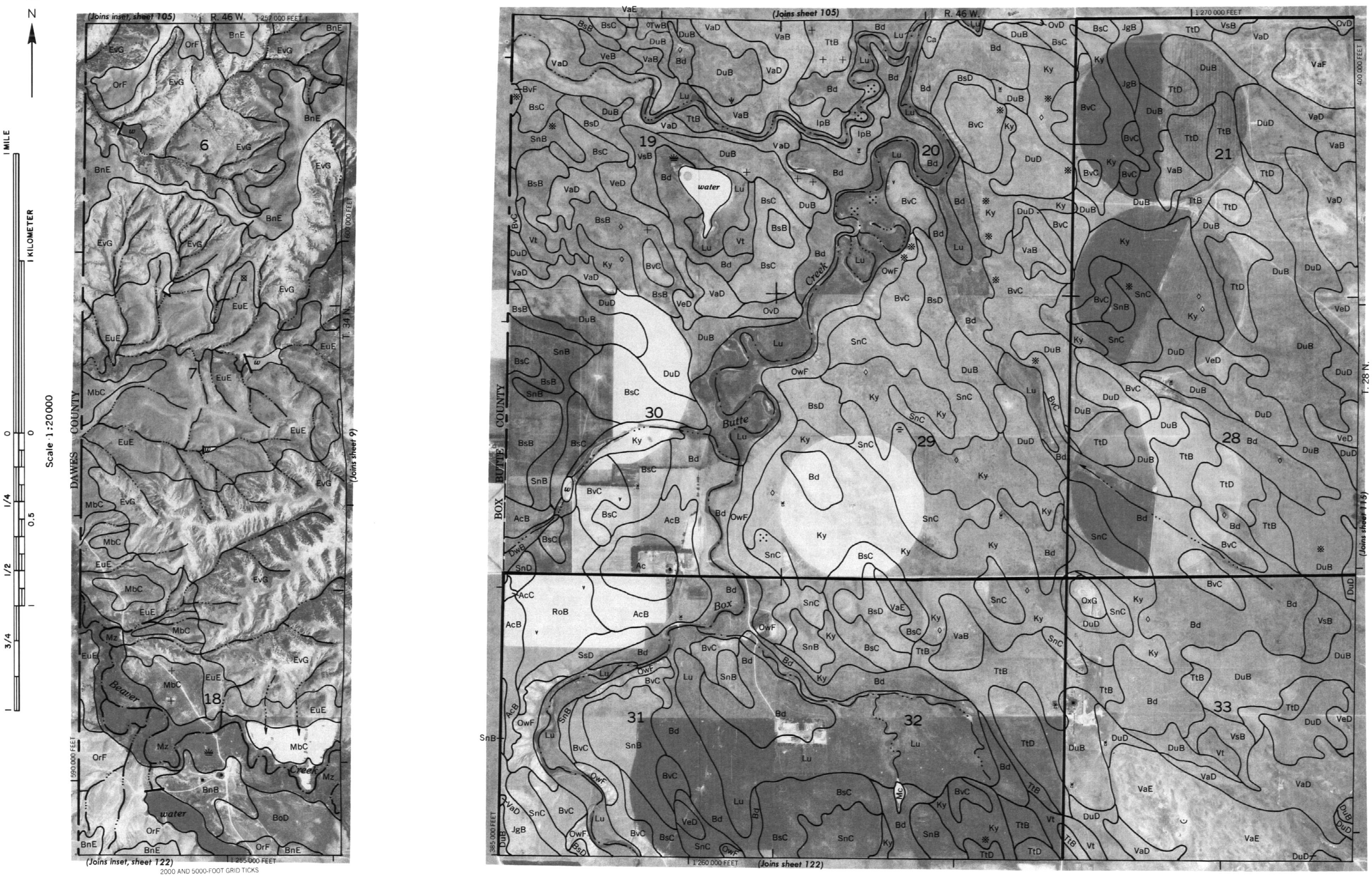
1 MILE

1 KILOMETER

0 1/4 1/2 3/4 1

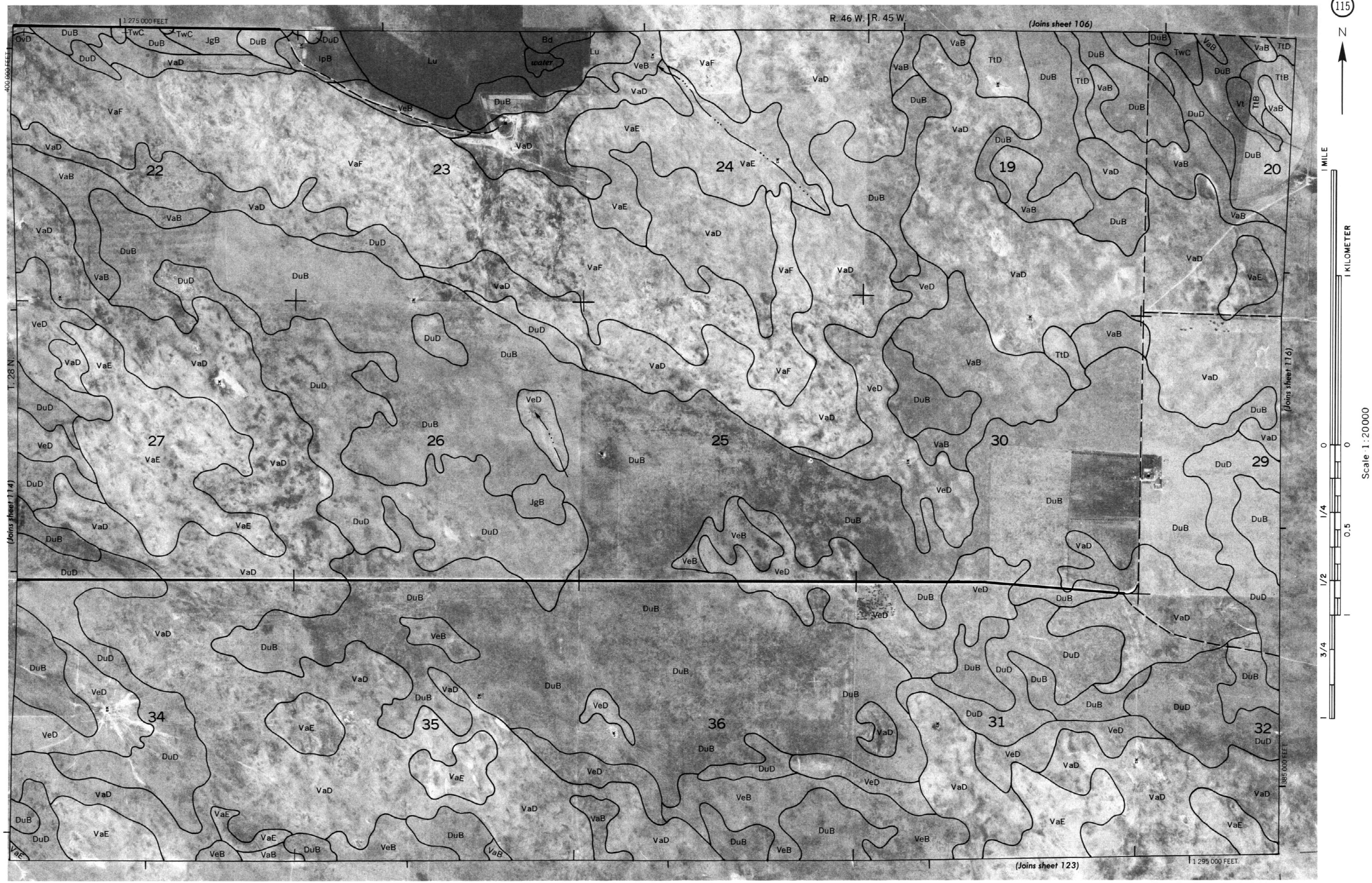
0 0.5 1

114



SHERIDAN COUNTY, NEBRASKA NO. 114

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1972 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 115

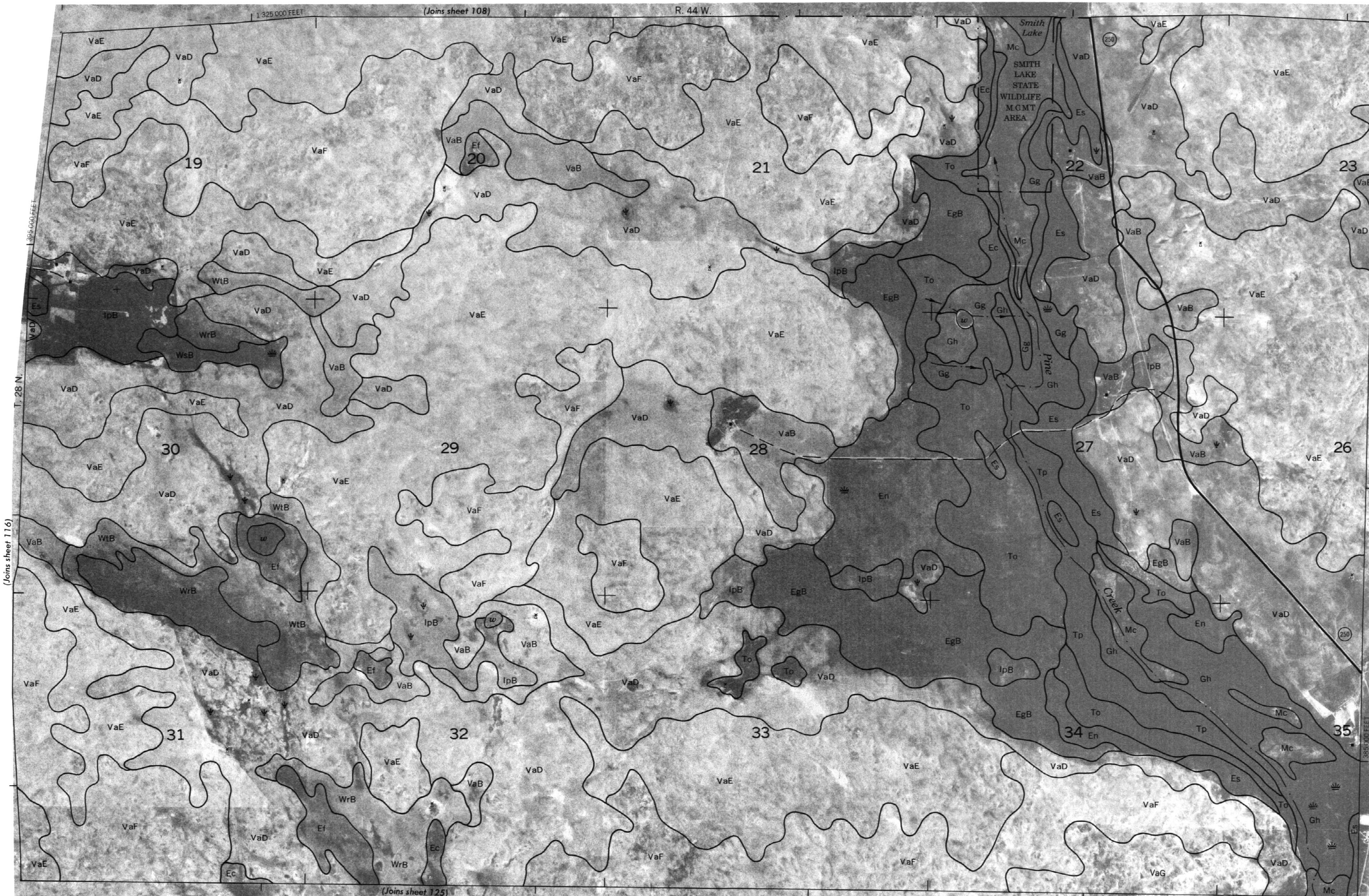
SHERIDAN COUNTY, NEBRASKA NO. 116

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

117

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 117



N

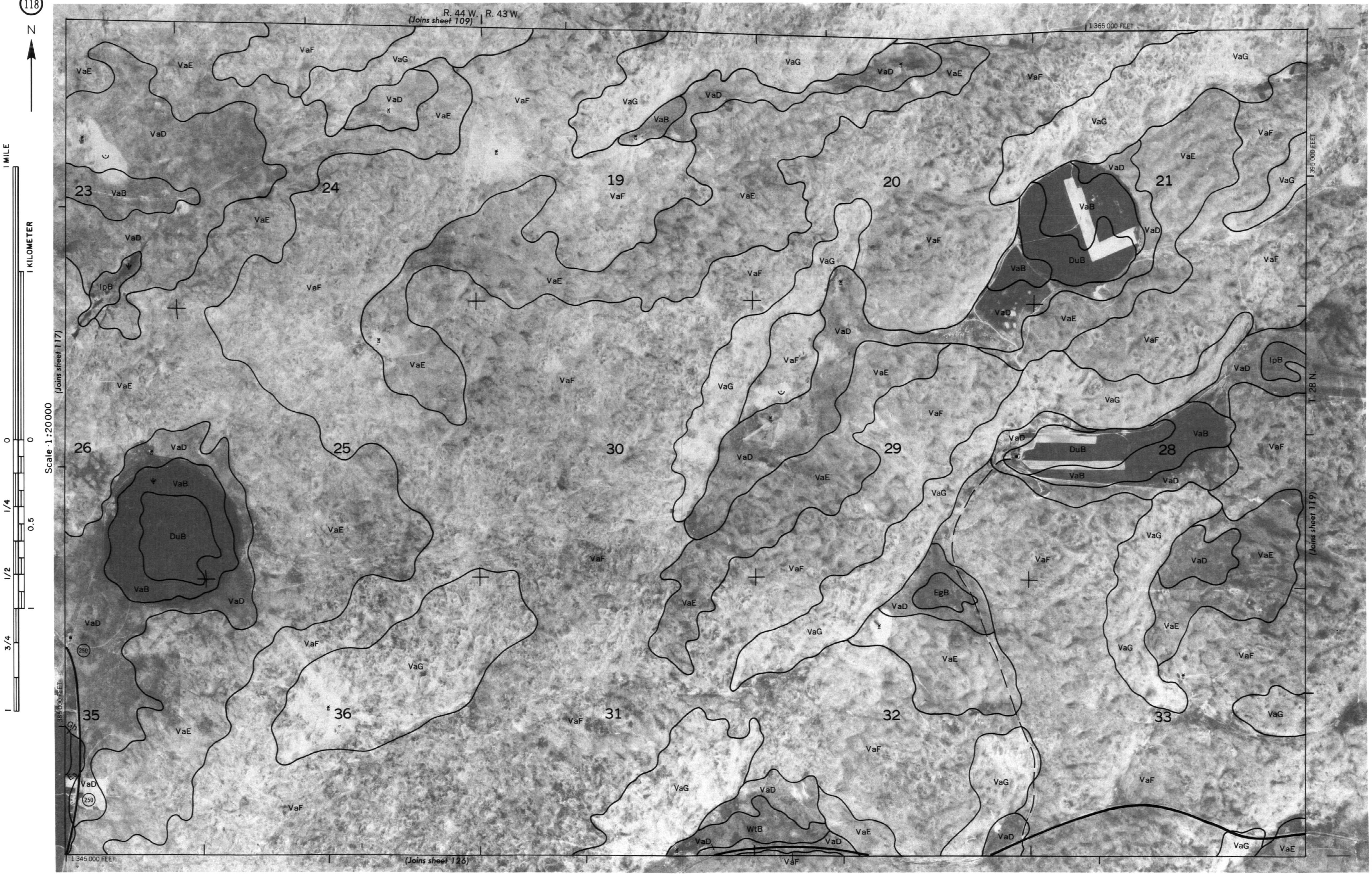
1 MILE

1 KILOMETER

0 1/4 1/2 3/4 1

0 0.5 1

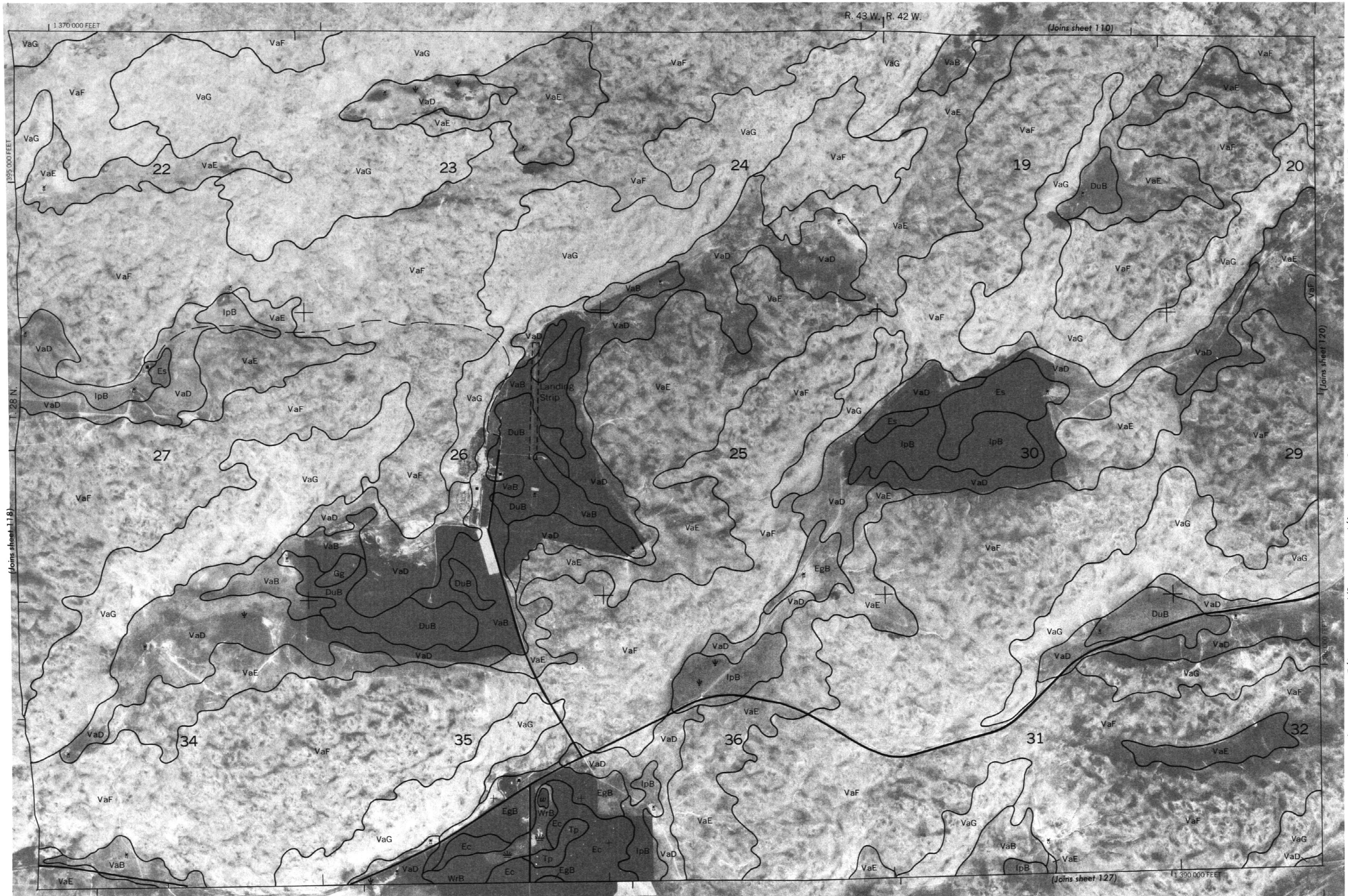
Scale 1:20000



SHERIDAN COUNTY, NEBRASKA NO. 118

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(119)



N

1 MILE

1 KILOMETER

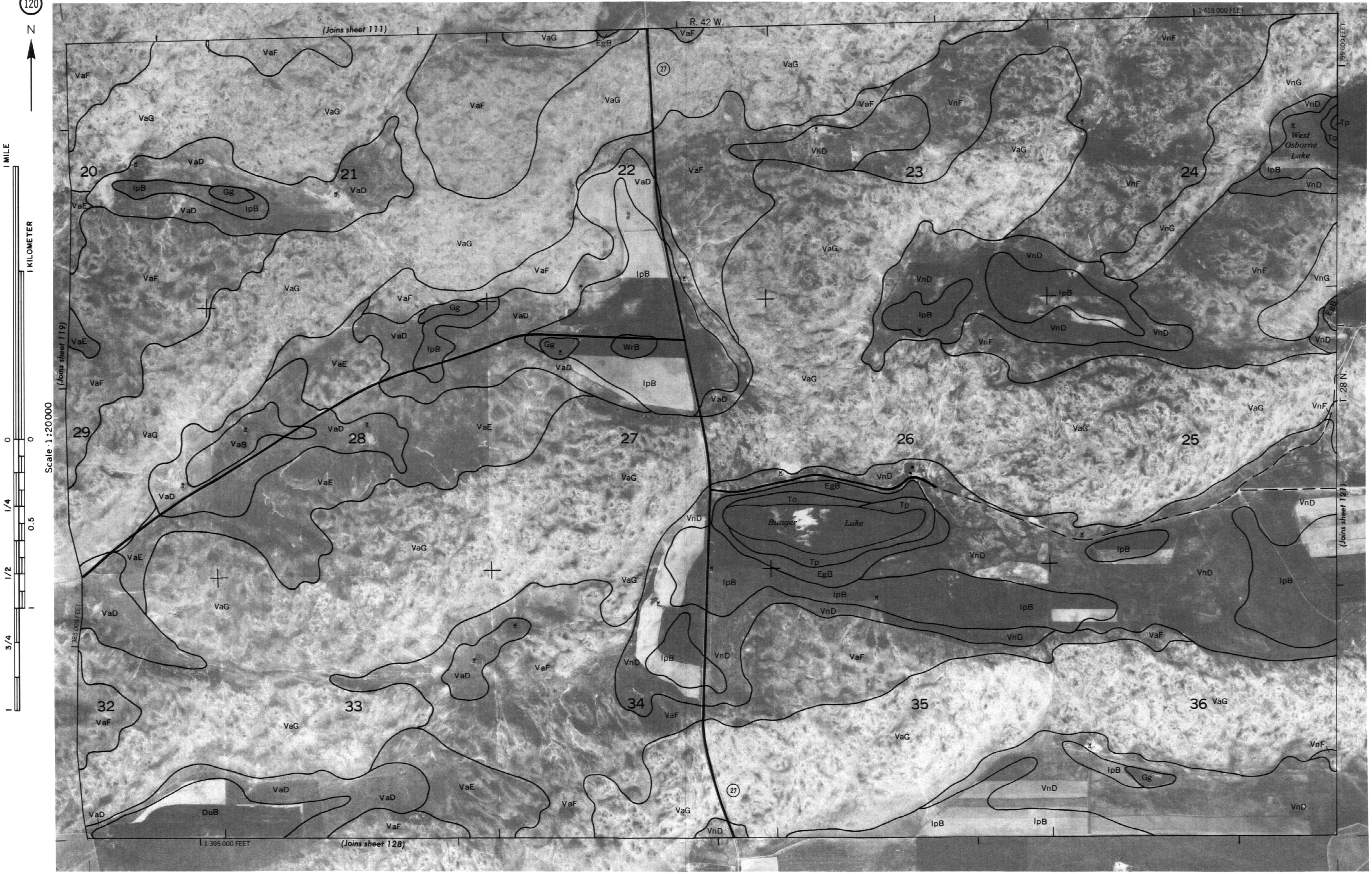
0 1/4 1/2 3/4 1

0 0.5 1

Scale 1:20000

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

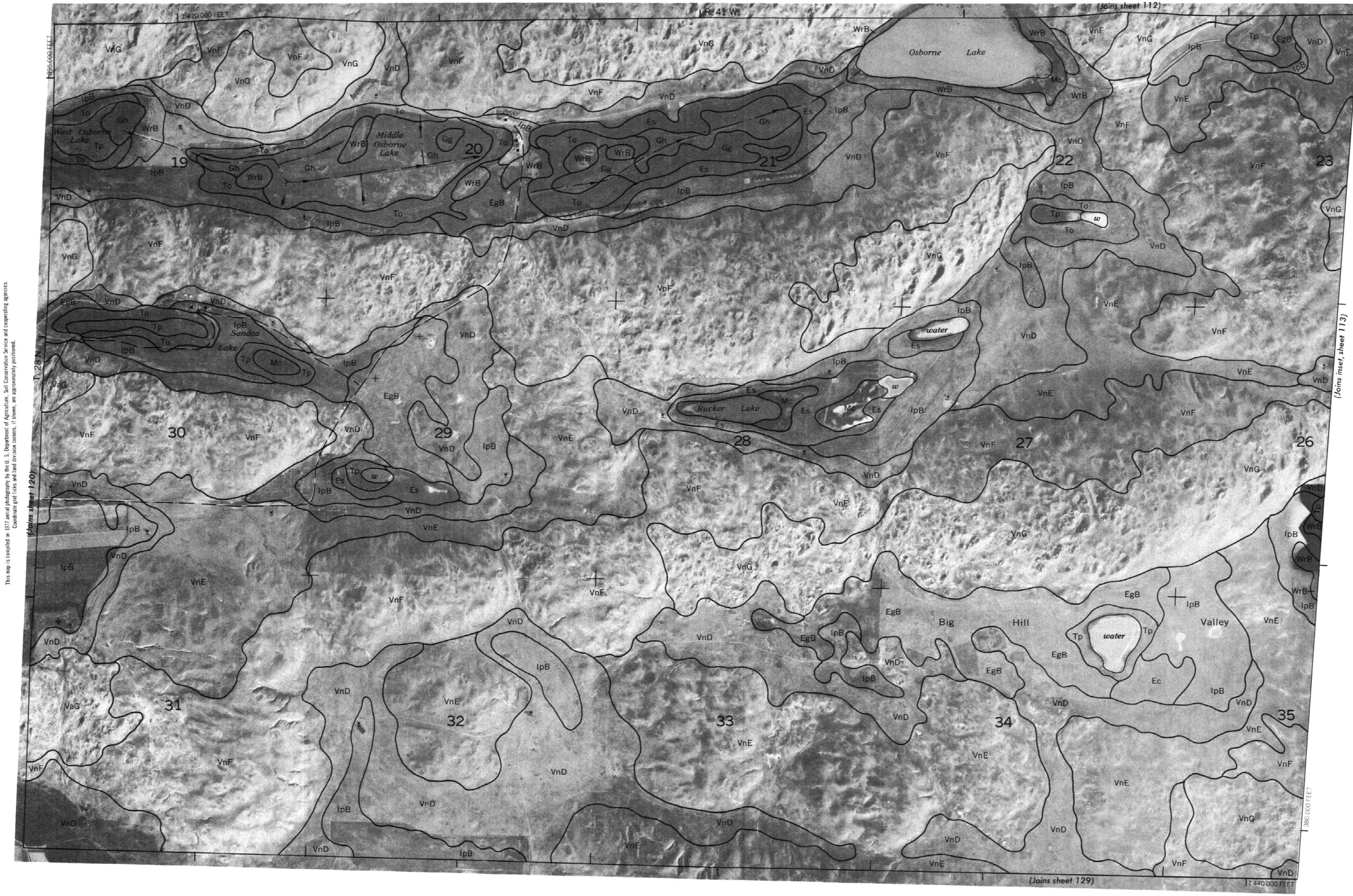
SHERIDAN COUNTY, NEBRASKA NO. 119



SHERIDAN COUNTY, NEBRASKA NO. 120

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

121



N

1 MILE

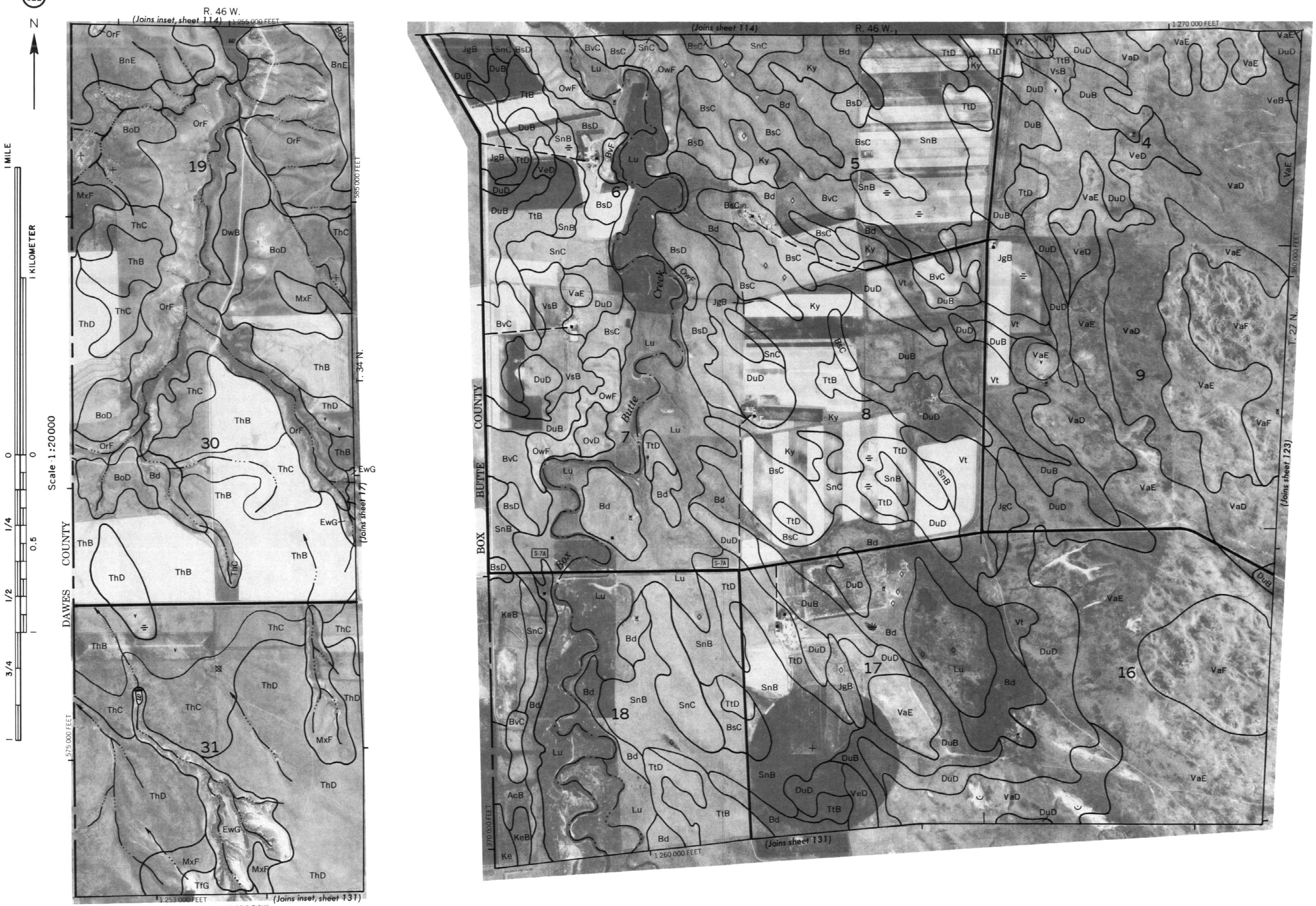
1 KILOMETER

0 1/4 1/2 3/4 1

0 0.5 1

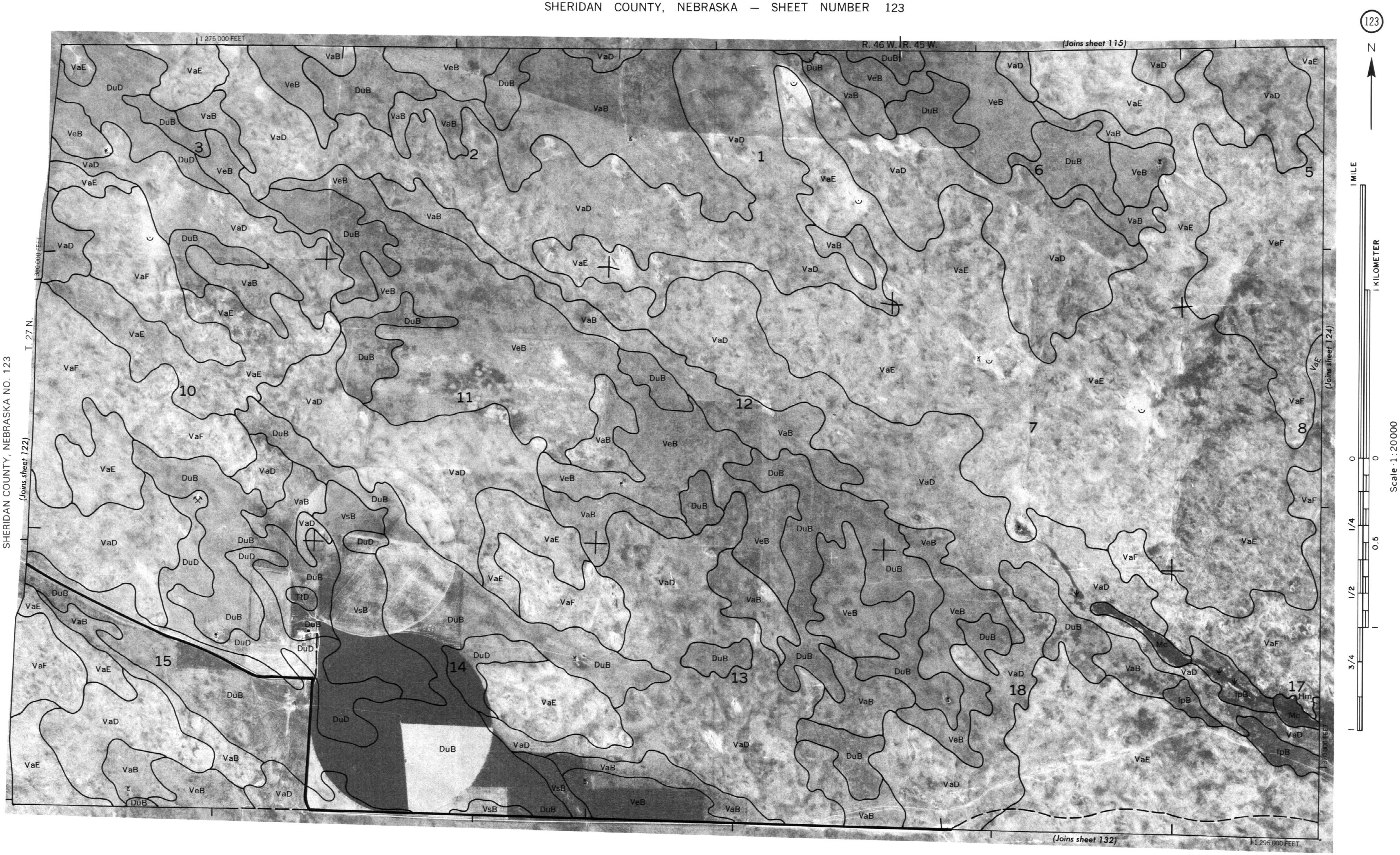
Scale 1:20000

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



SHERIDAN COUNTY, NEBRASKA NO. 122

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



SHERIDAN COUNTY, NEBRASKA NO. 123

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

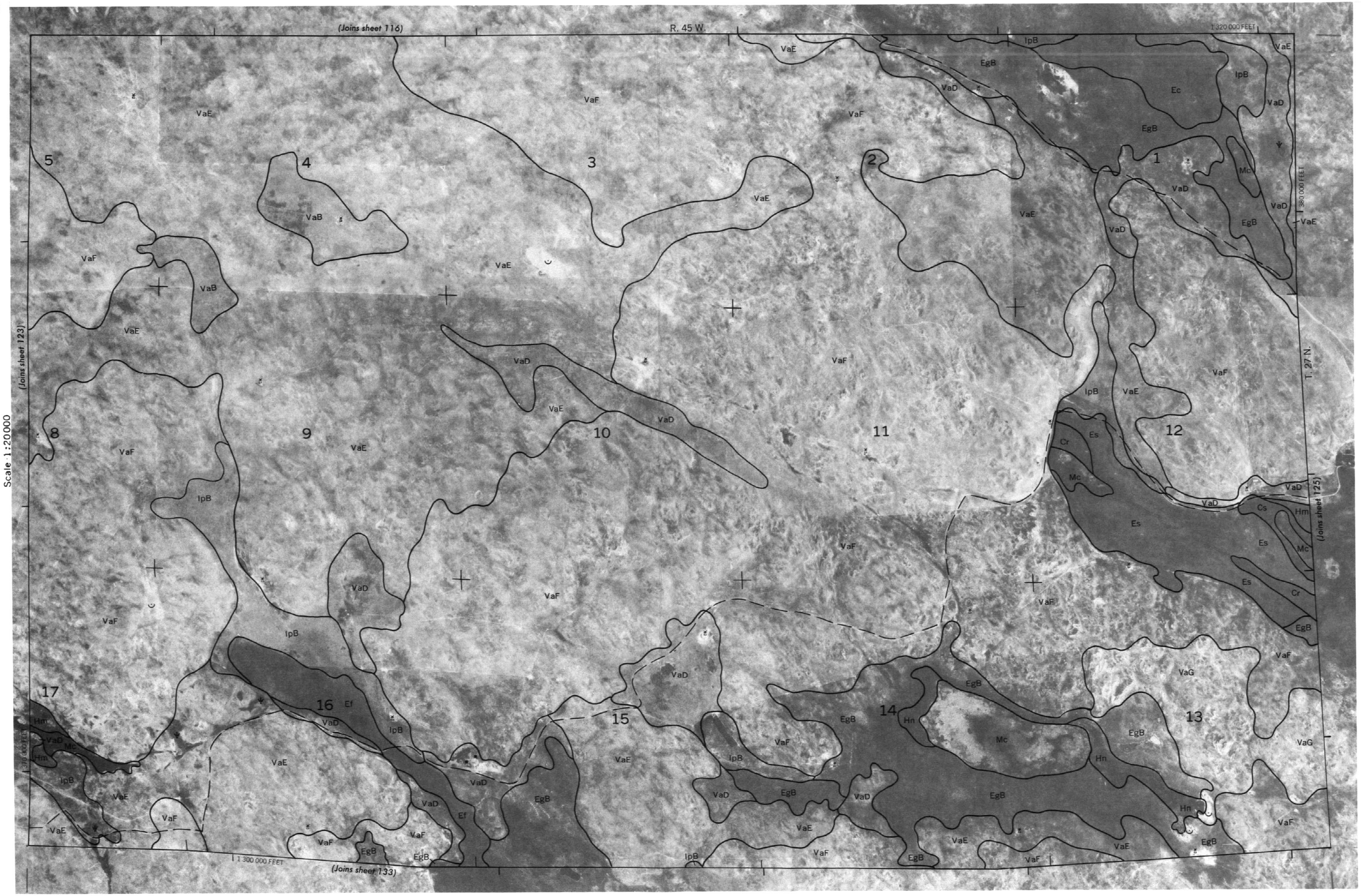
SHERIDAN COUNTY, NEBRASKA — SHEET NUMBER 124

N

1 MILE

1 KILOMETER

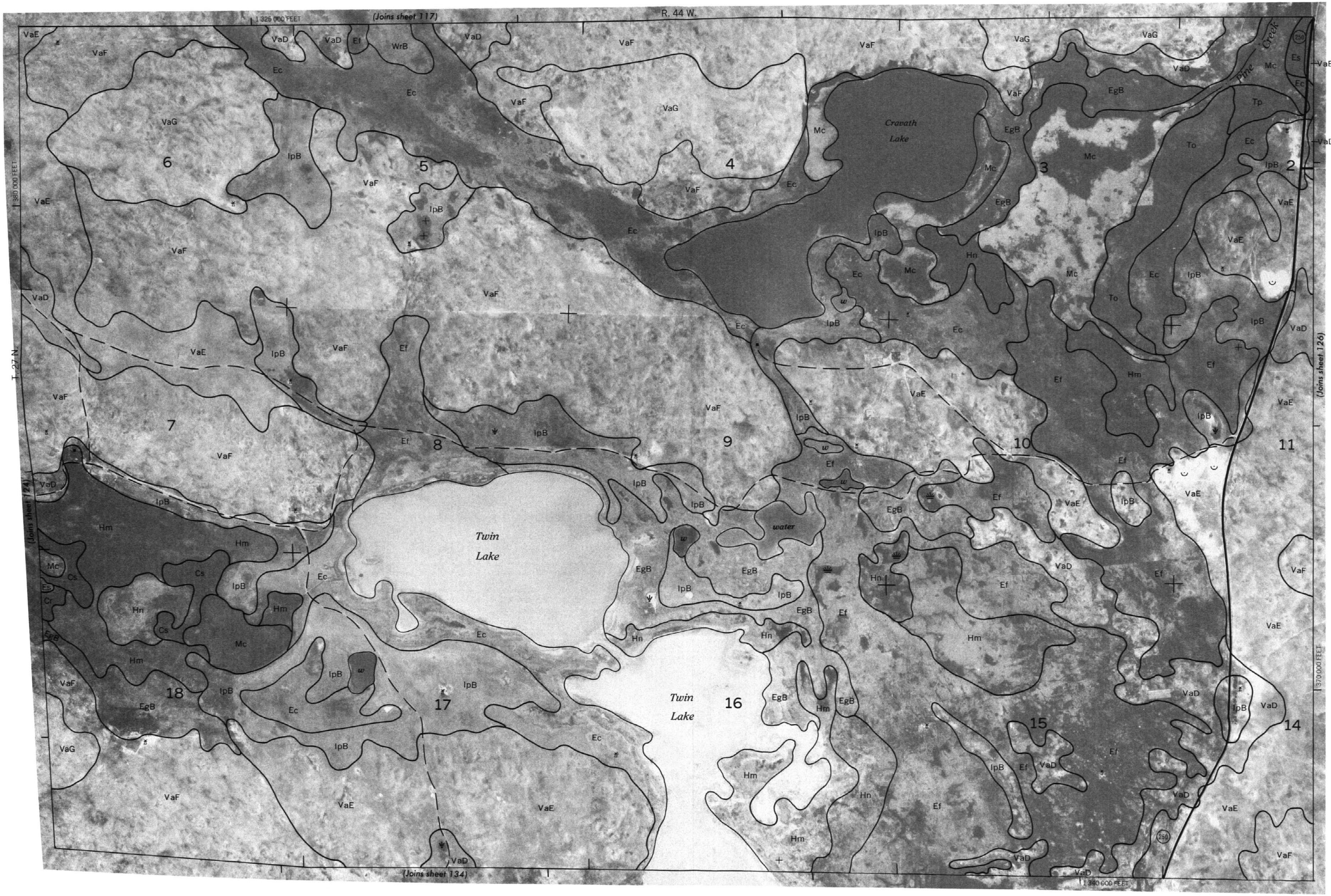
Scale 1:20000



SHEETS COUNTY, NEBRASKA NO. 124

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(125)

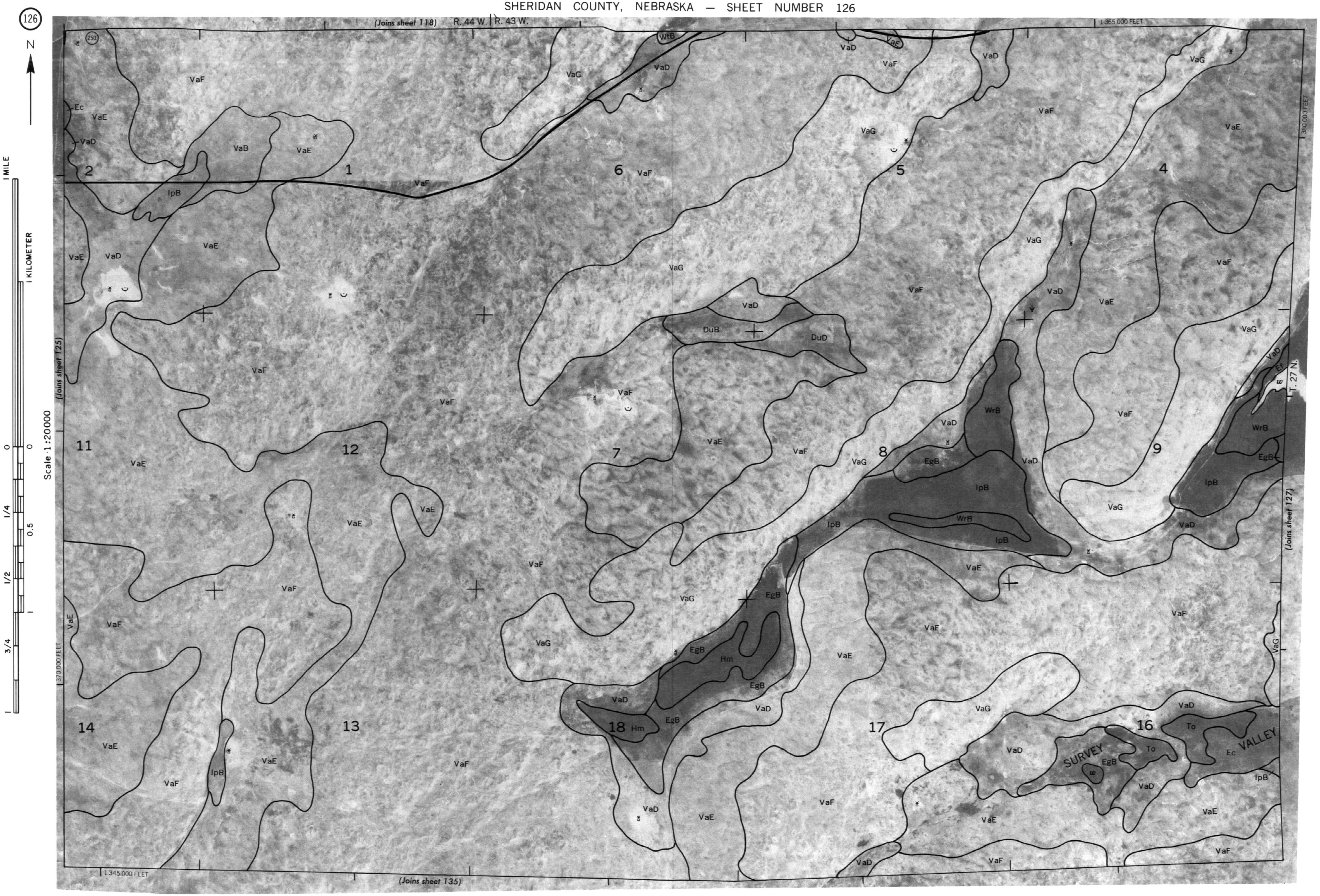


N

1 MILE
1 KILOMETER
0 1/4 1/2 3/4 1
0 0.5 1
Scale 1:20000

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 125

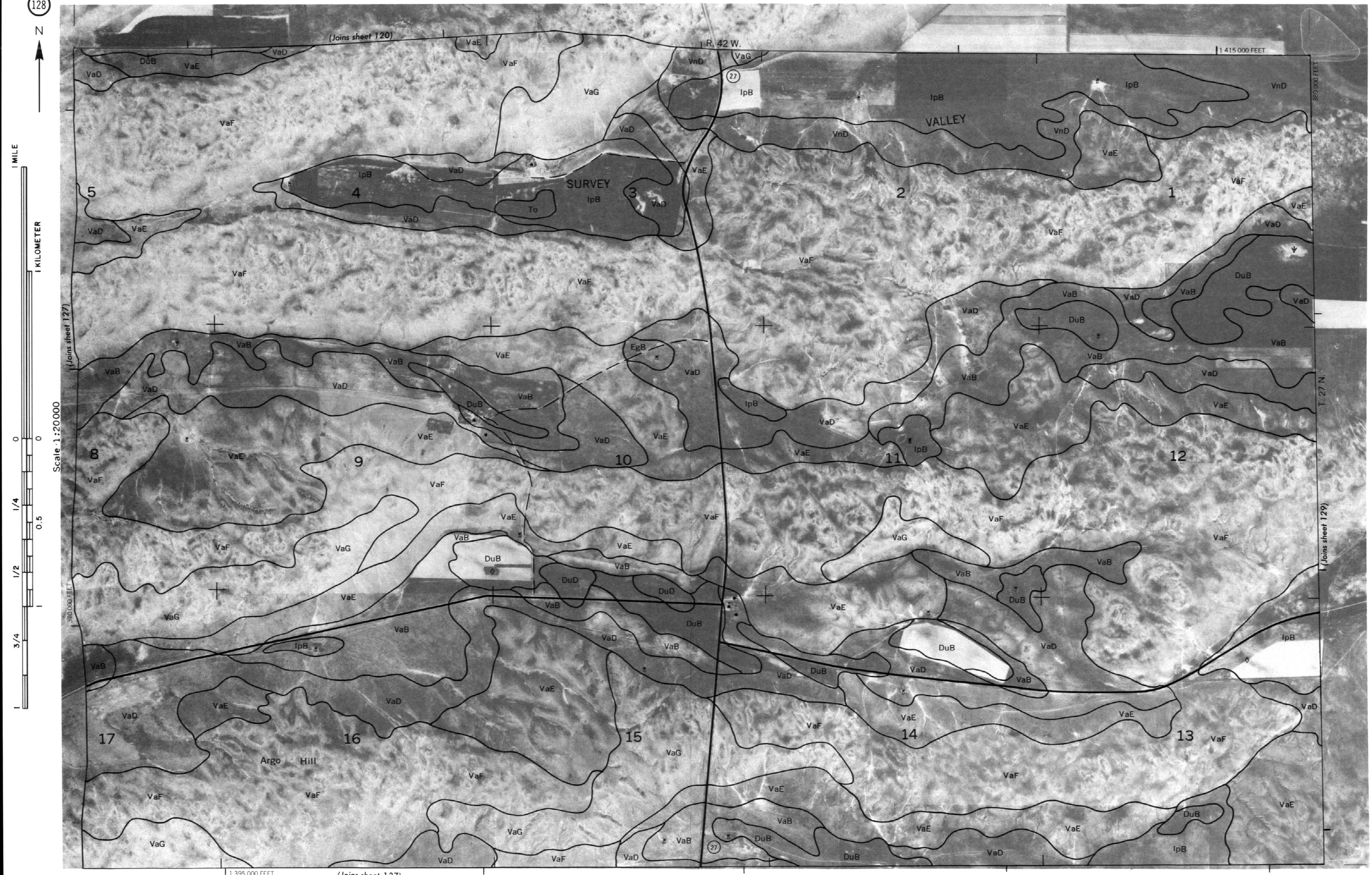


SHERIDAN COUNTY, NEBRASKA NO. 126

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

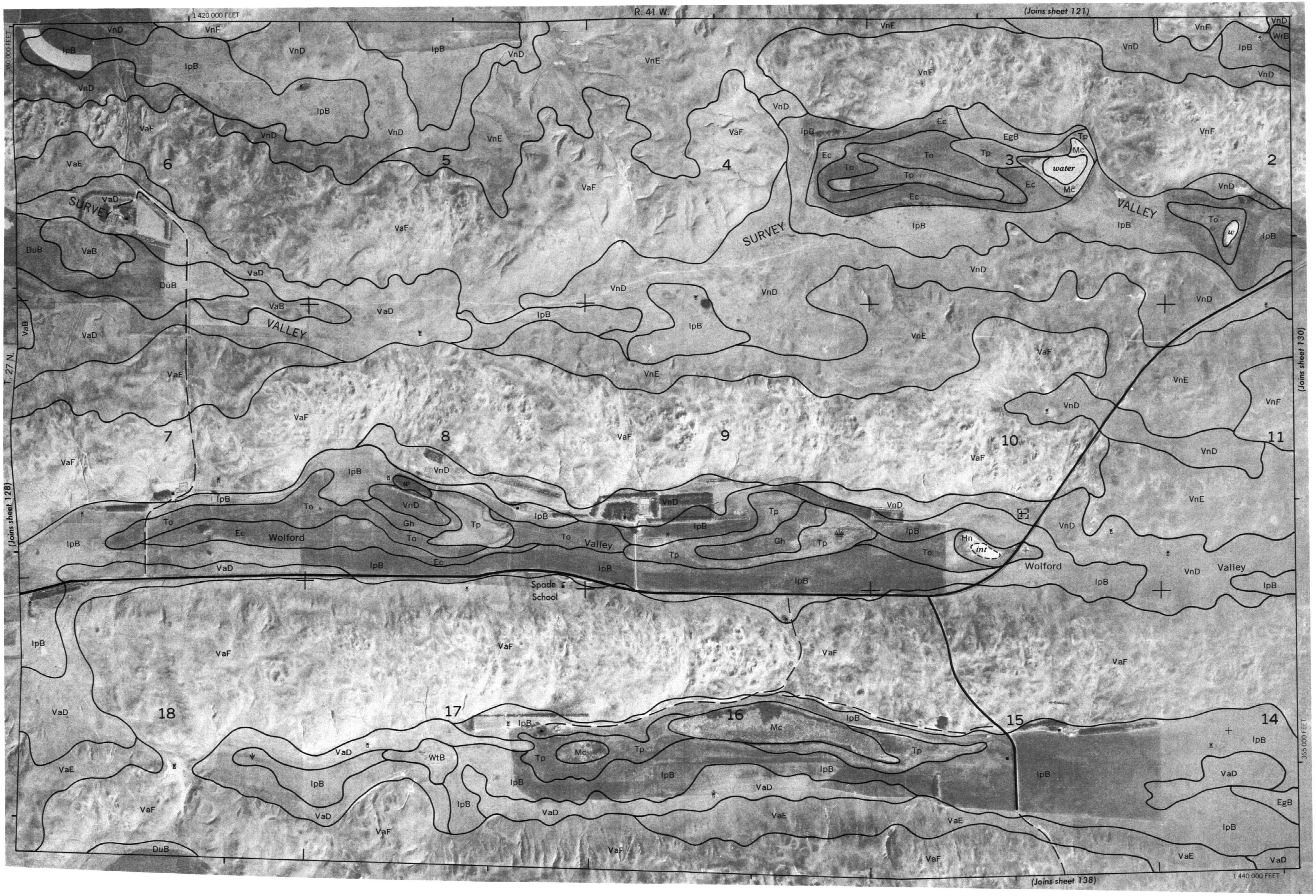
SHERIDAN COUNTY, NEBRASKA NO. 127



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(129)

N



1 MILE

1 KILOMETER

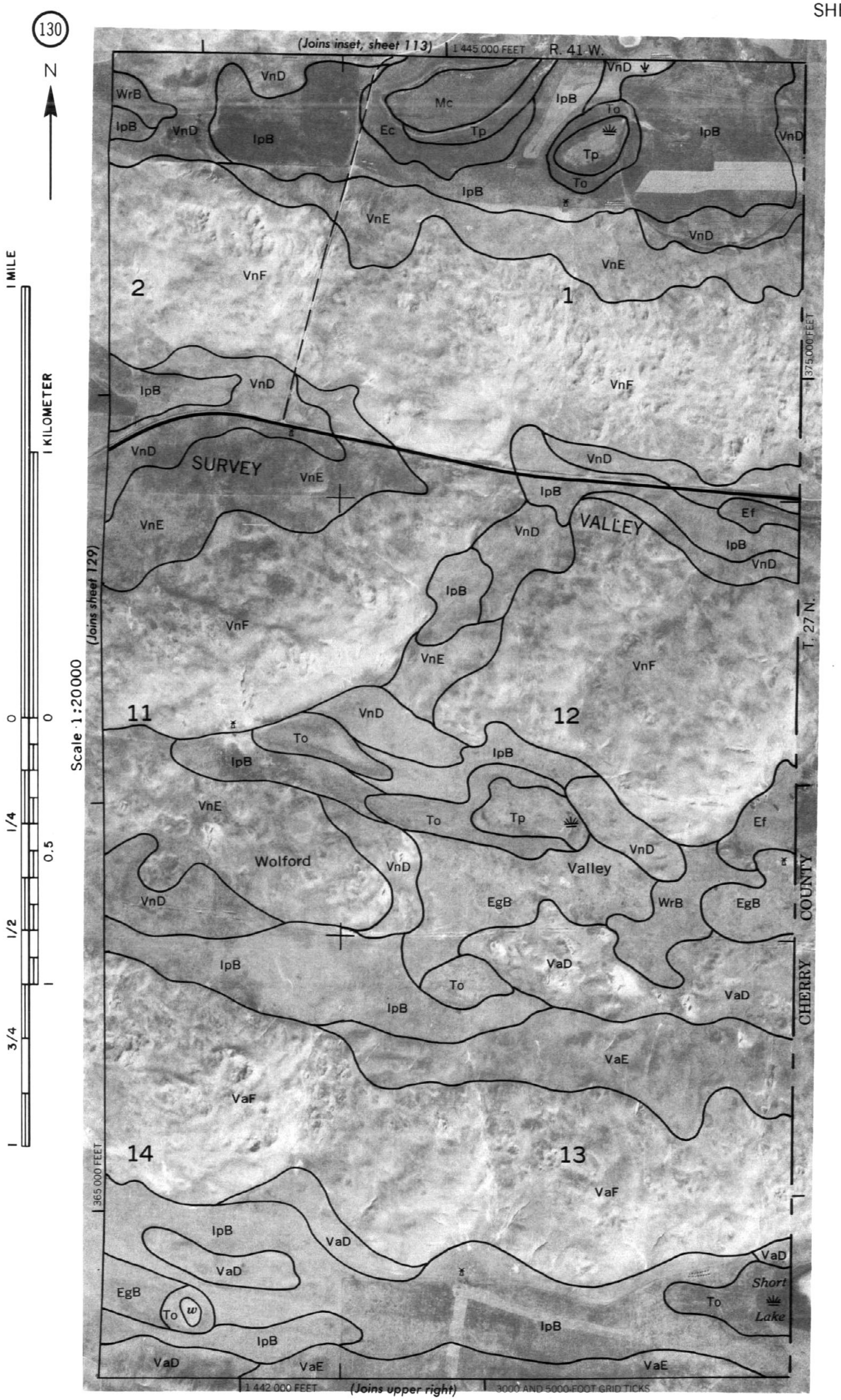
0 1/4 1/2 3/4 1

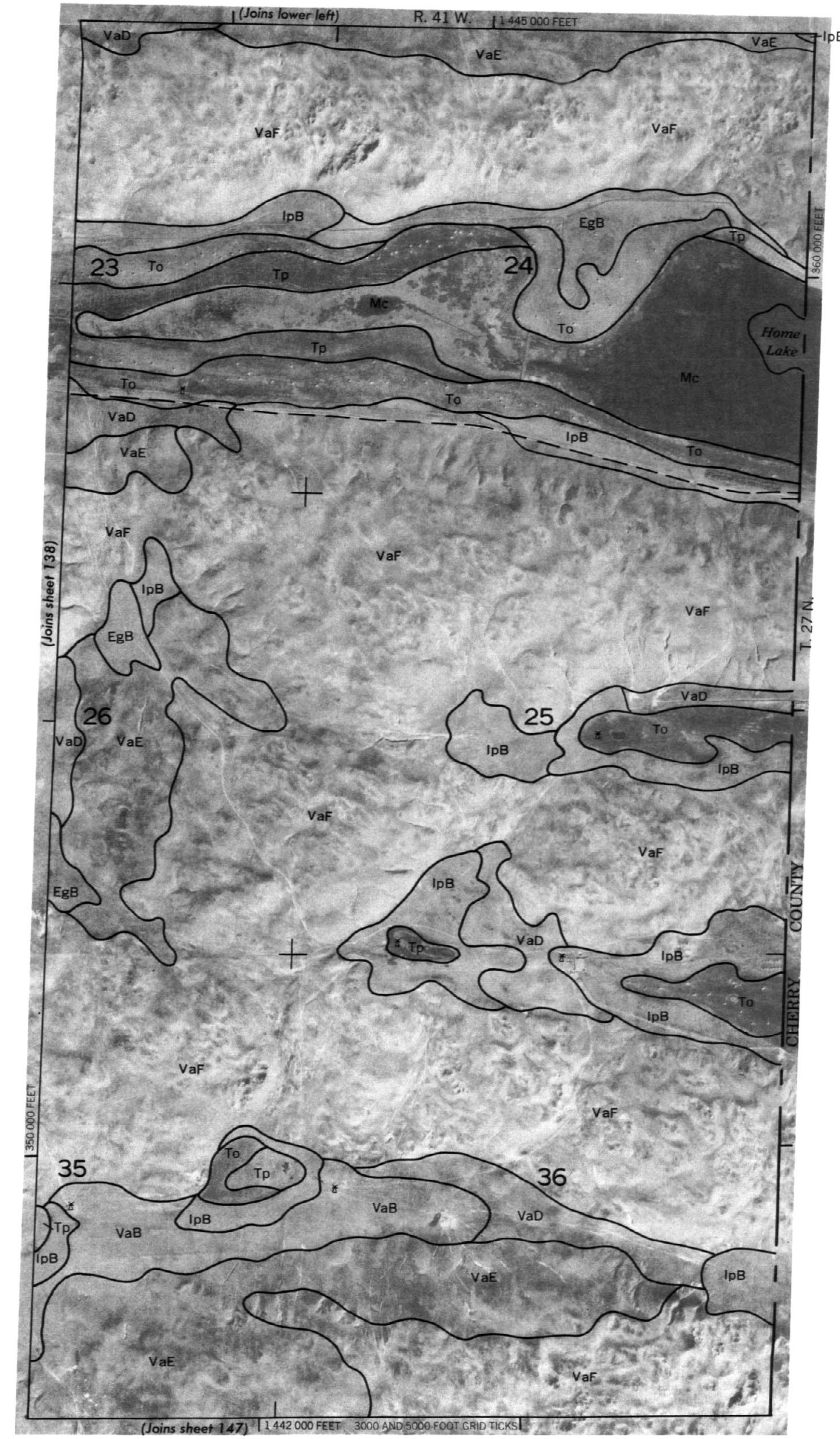
0 0.5 1

Scale 1:20000

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 129

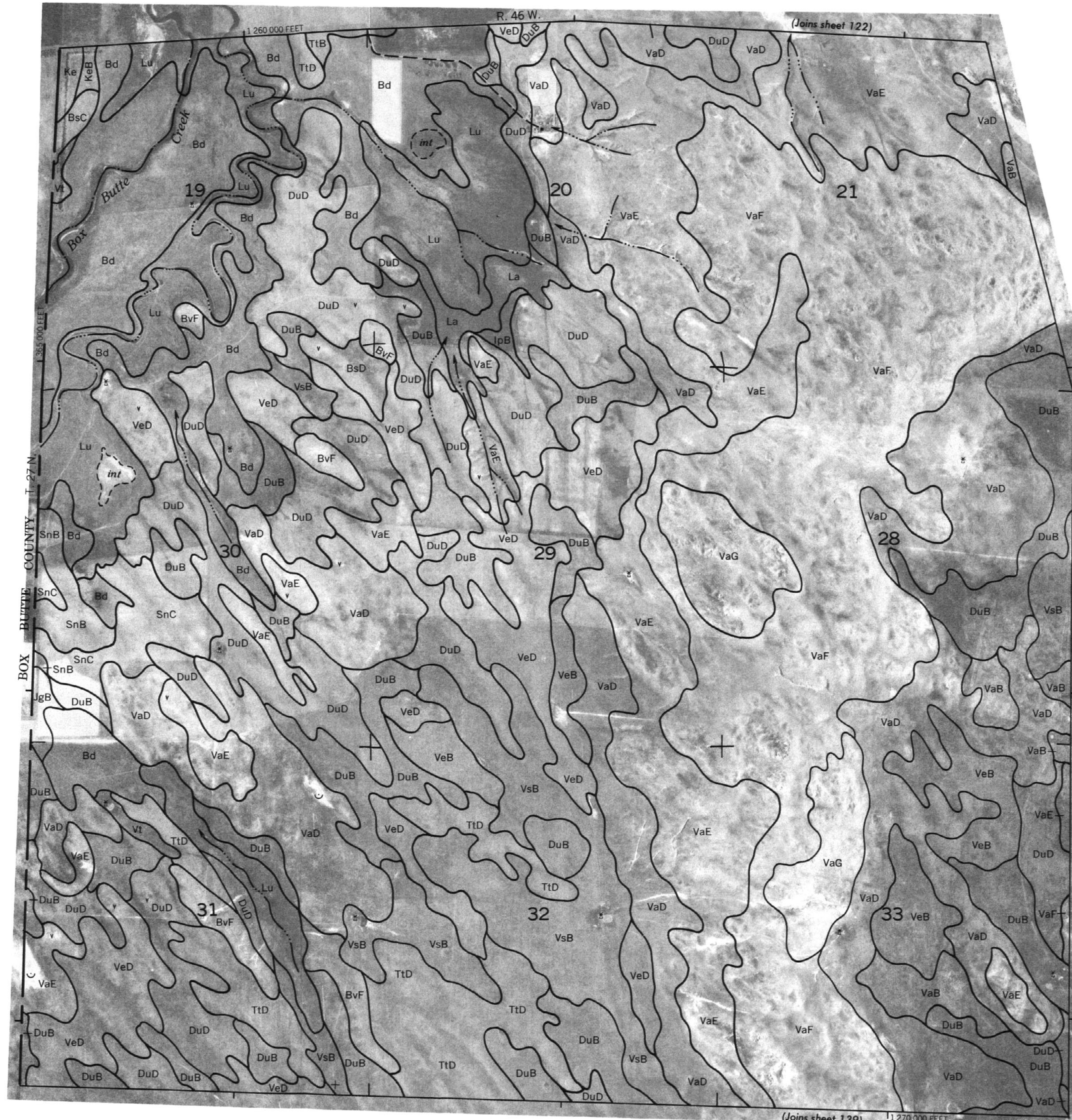


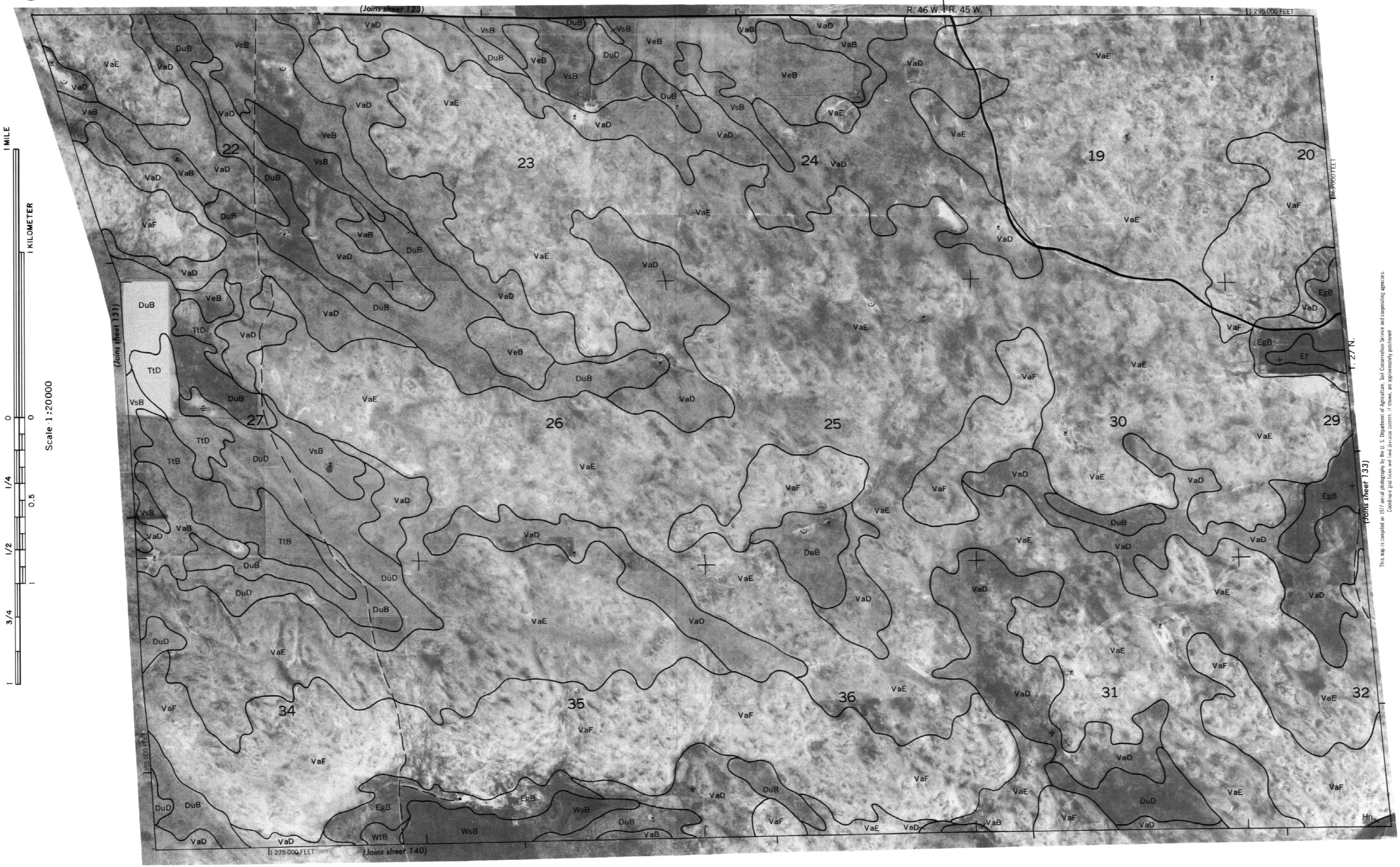


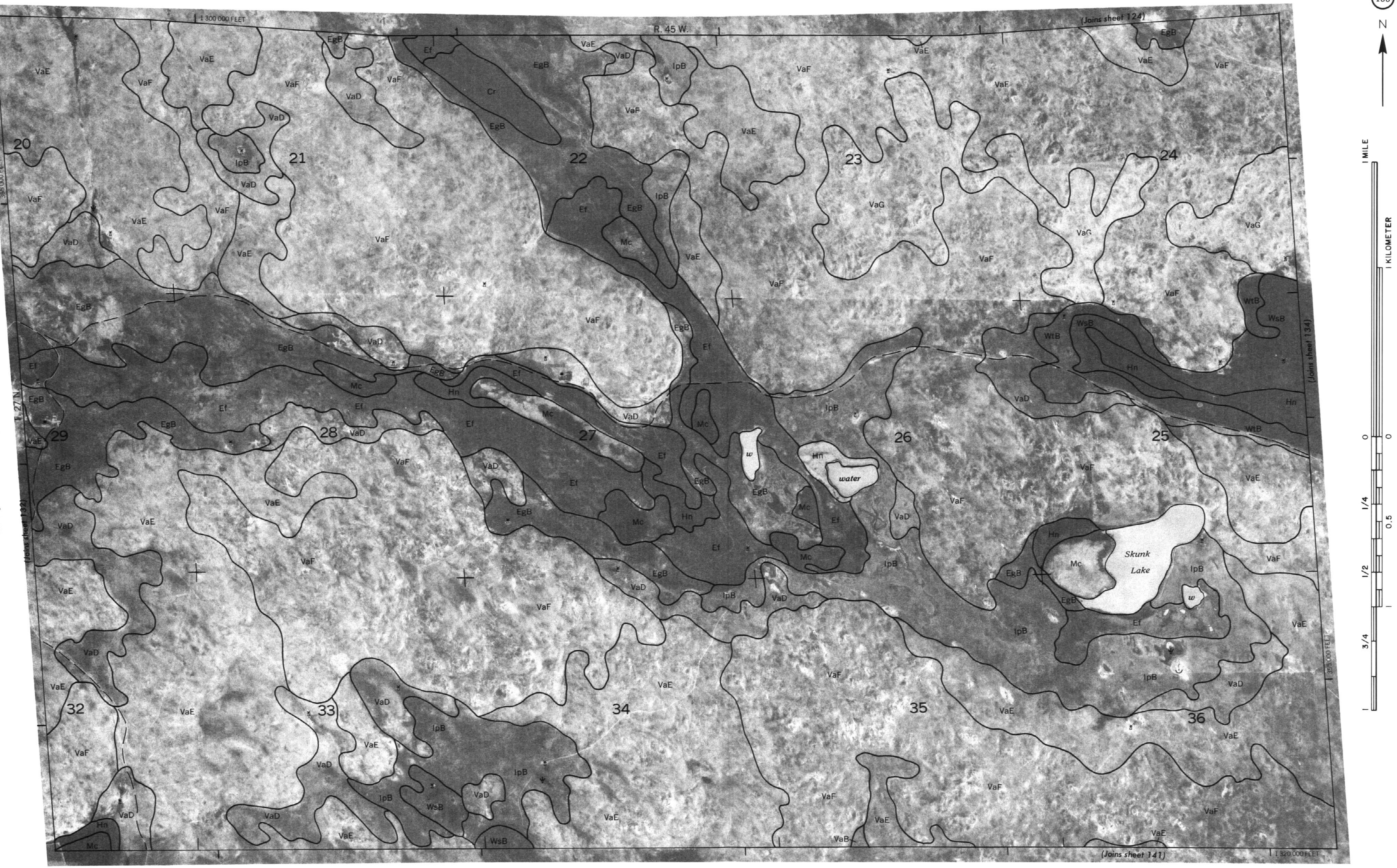
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

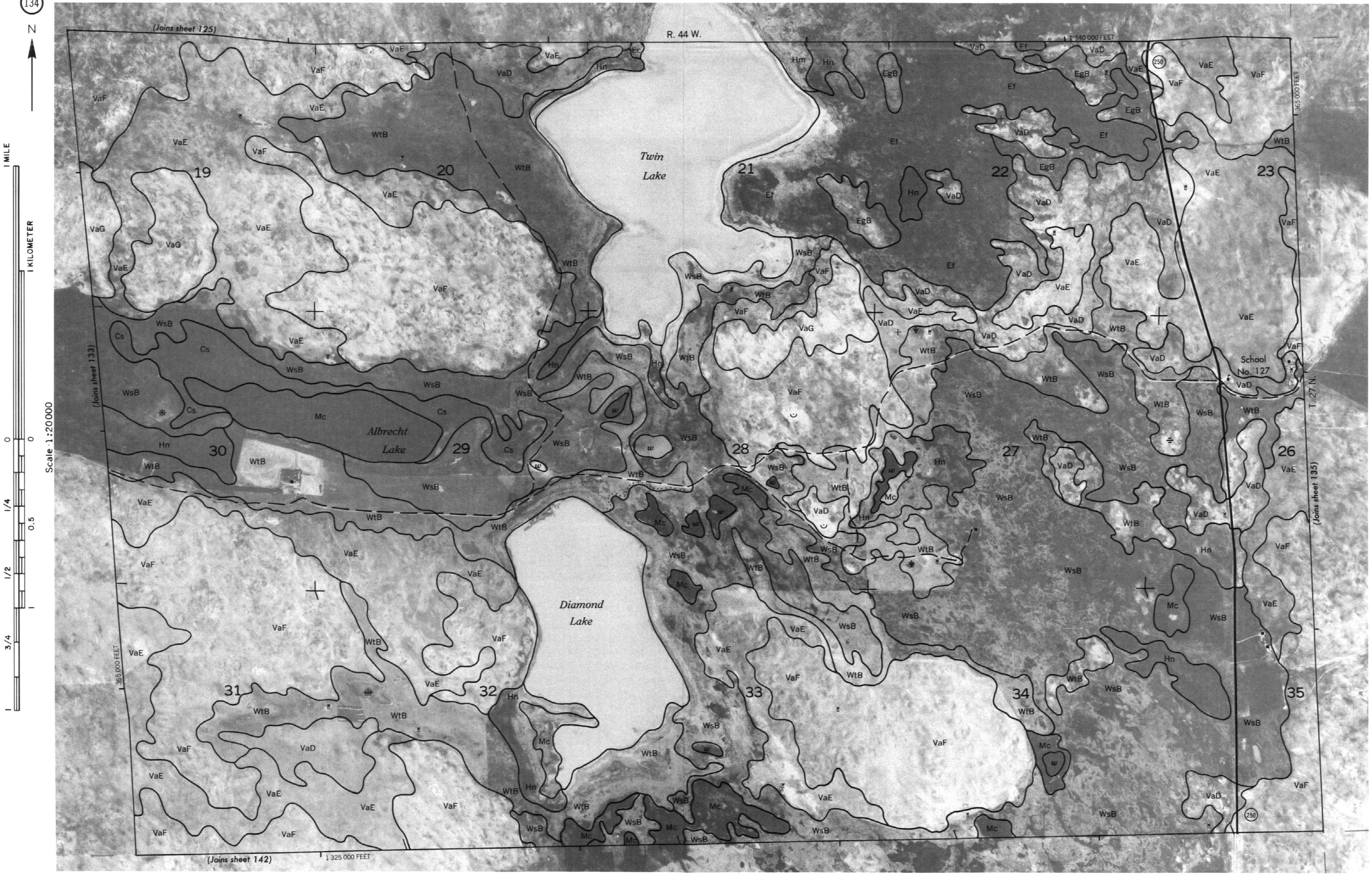
SHERIDAN COUNTY, NEBRASKA NO. 131




(Joins sheet 123)
R. 46 W.
R. 45 W.
1 295 000 FEET
(Joins sheet 131)
(Joins sheet 133)
T. 27 N.
(Joins sheet 140)
1 275 000 FEET
355 000 FEET
365 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32
VaD
VaE
VaF
VaB
VeB
VsB
DuB
DuD
TtD
TtB
EgB
Ef
WsB
WtB
Hn
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



SHERIDAN COUNTY, NEBRASKA NO. 134

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 135

N

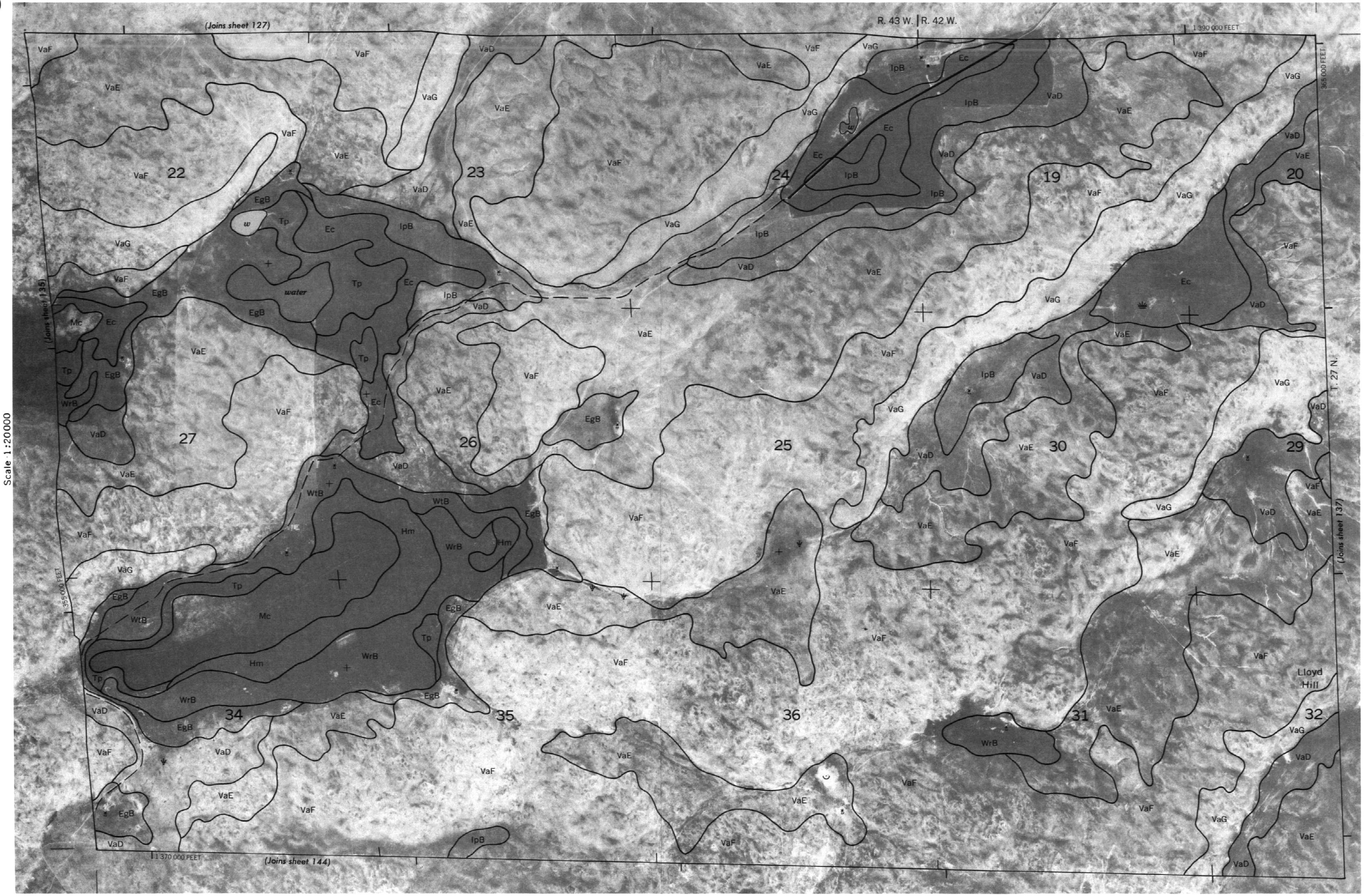
1 MILE

1 KILOMETER

Scale 1:20000

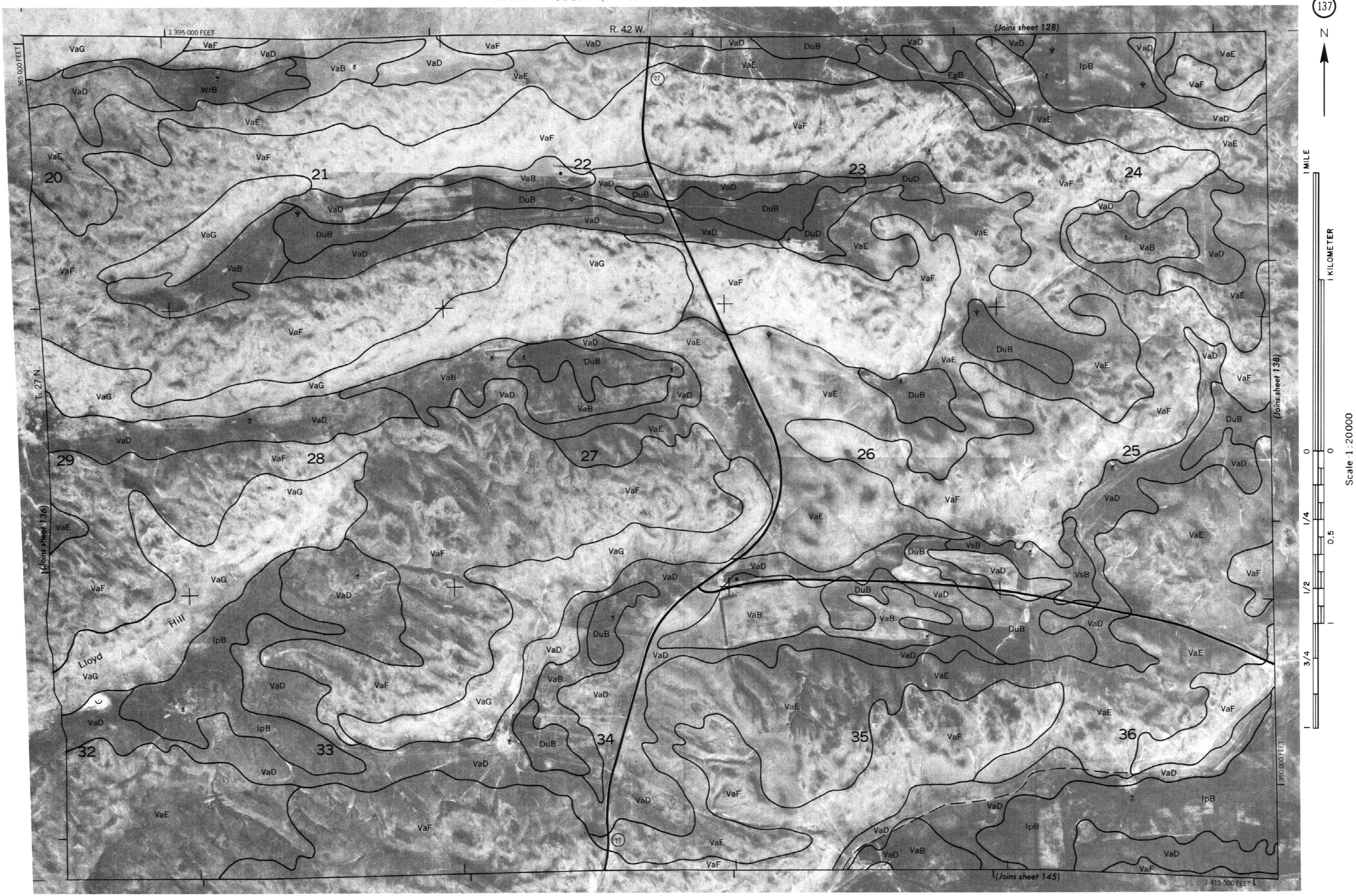
0 1/4 1/2 3/4 1

0 0.5 1



SHERIDAN COUNTY, NEBRASKA NO. 136

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 137

SHERIDAN COUNTY, NEBRASKA — SHEET NUMBER 138

N

1 MILE

1 KILOMETER

Scale 1:20000

0 1/4 1/2 3/4 1

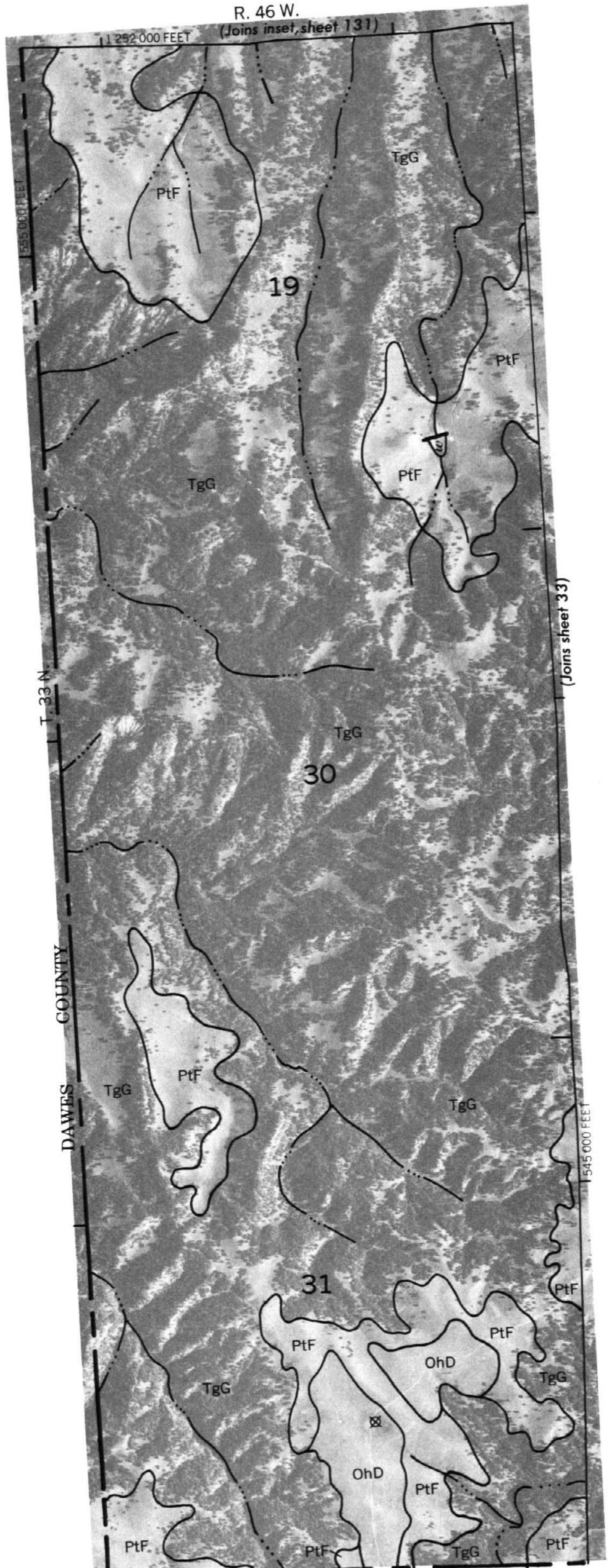
0 0.5 1

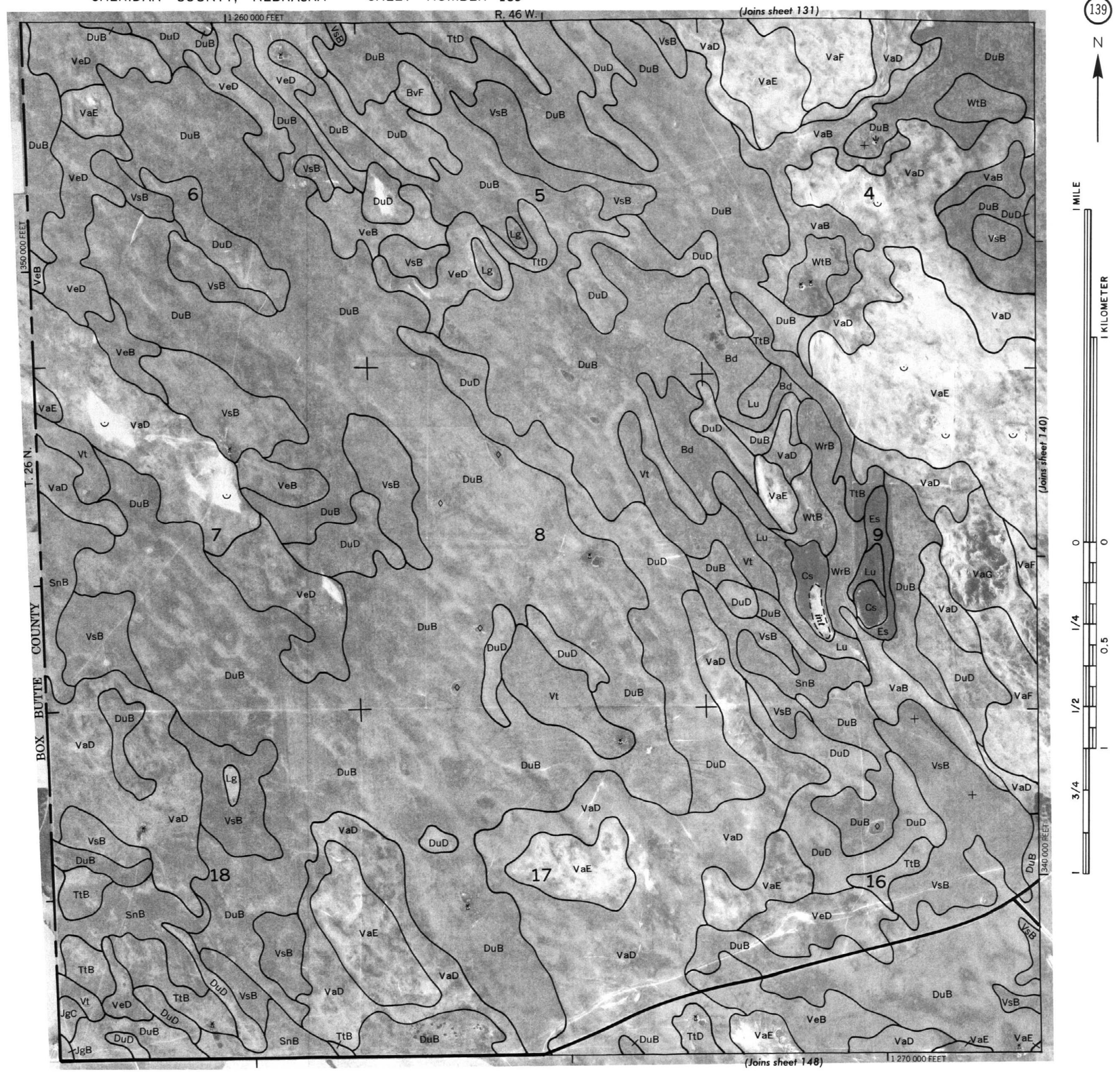
SHERIDAN COUNTY, NEBRASKA NO. 138

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 139



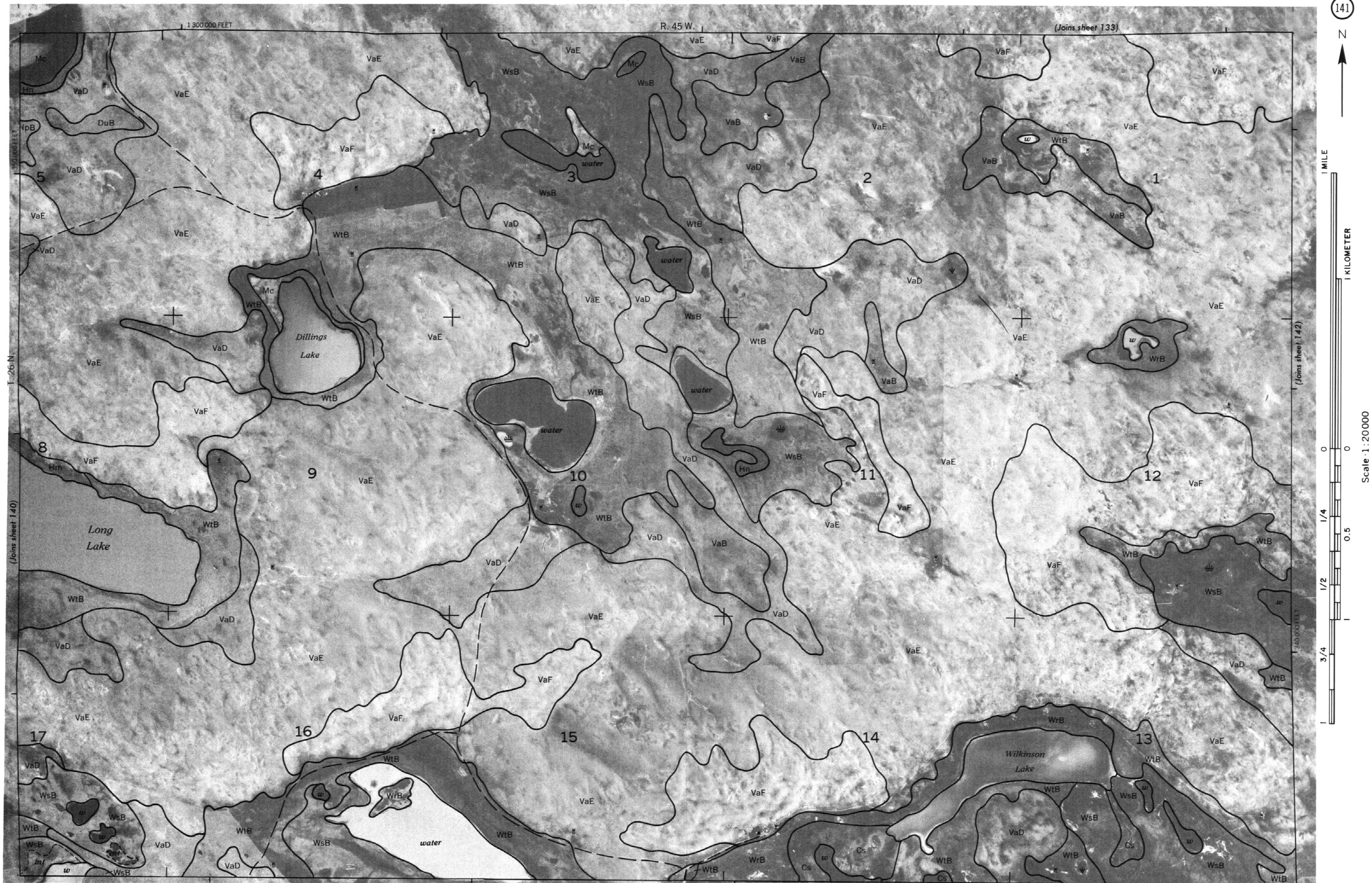


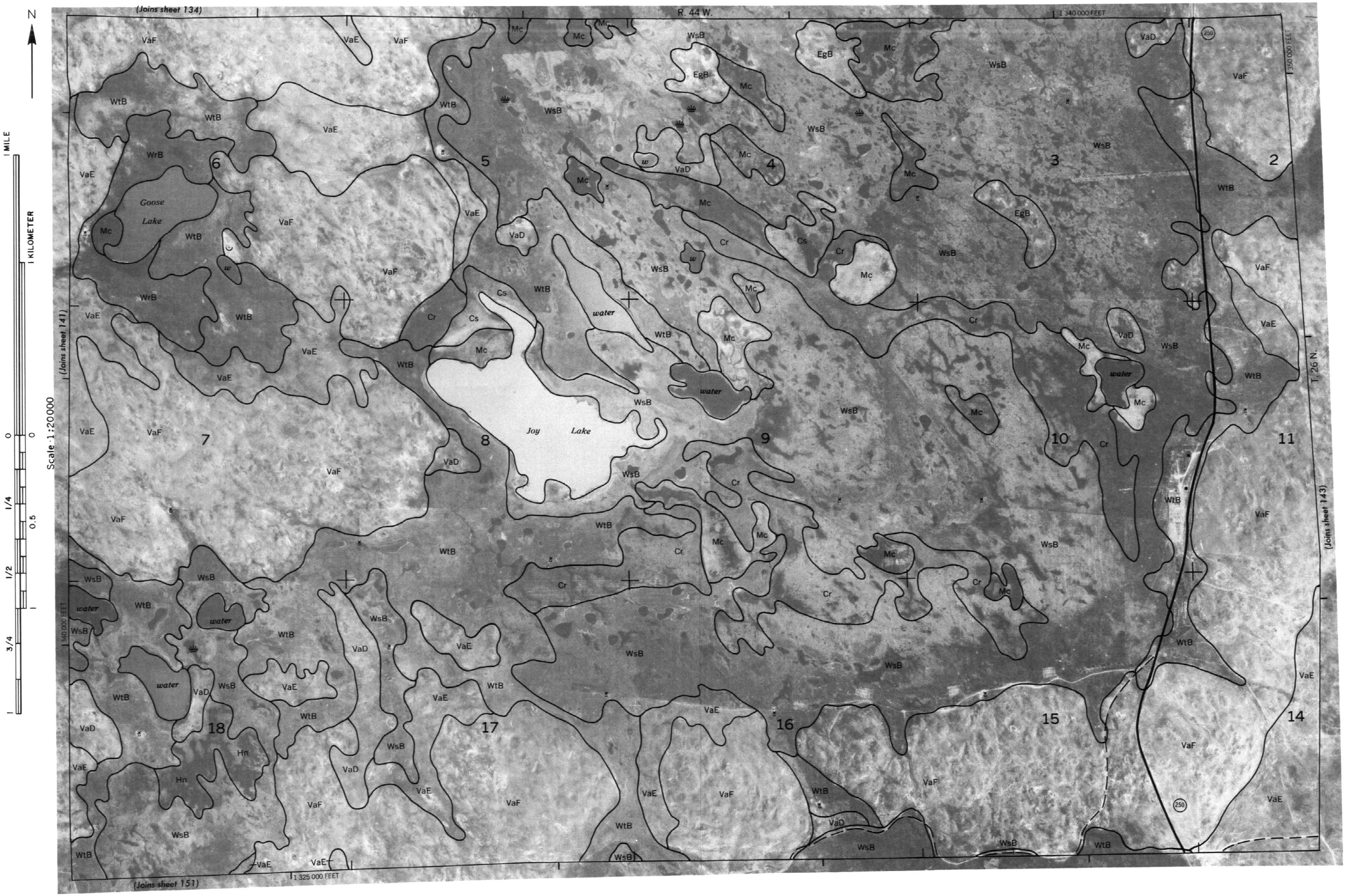
SHERIDAN COUNTY, NEBRASKA NO. 140

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 141

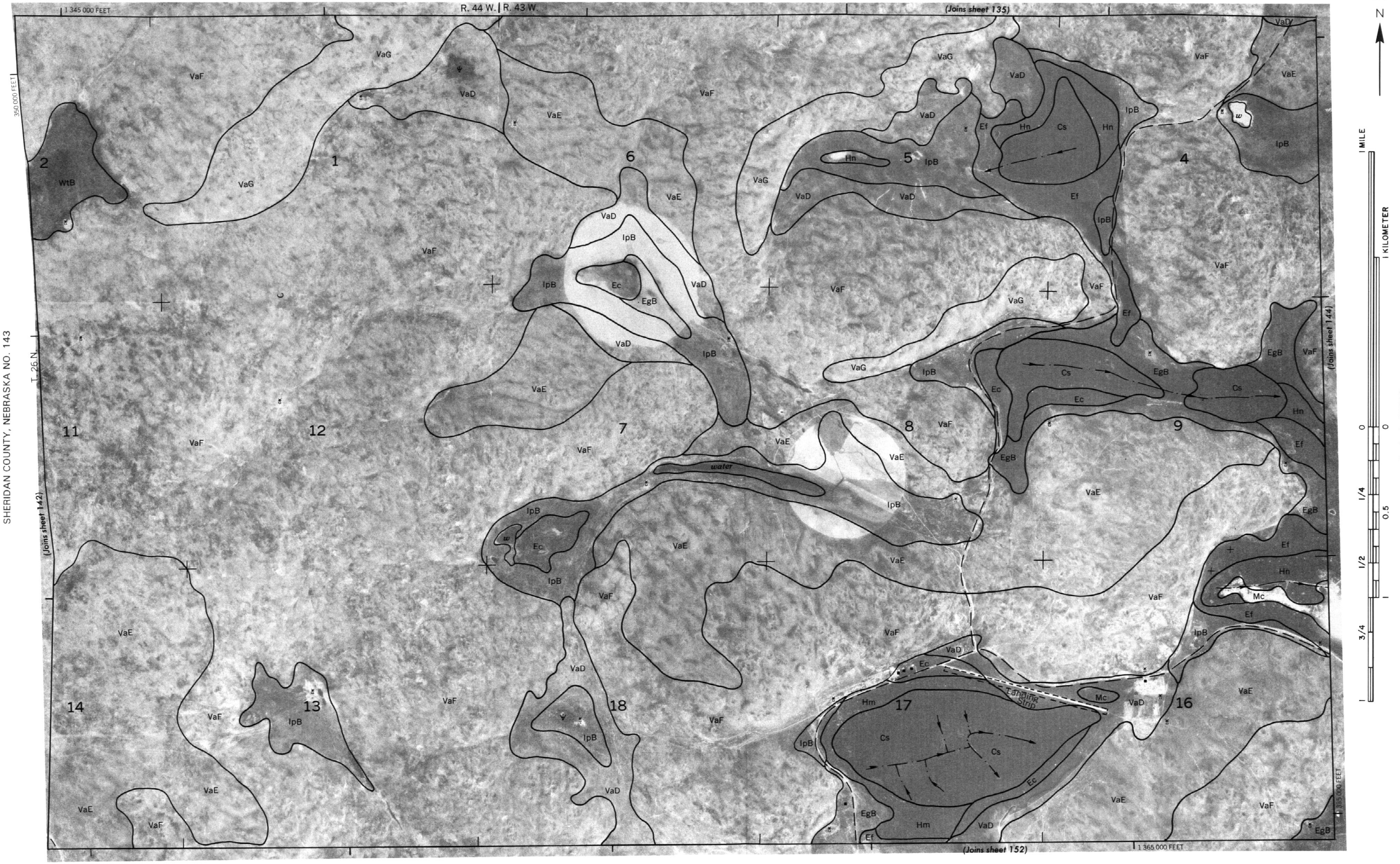




SHERIDAN COUNTY, NEBRASKA NO. 142

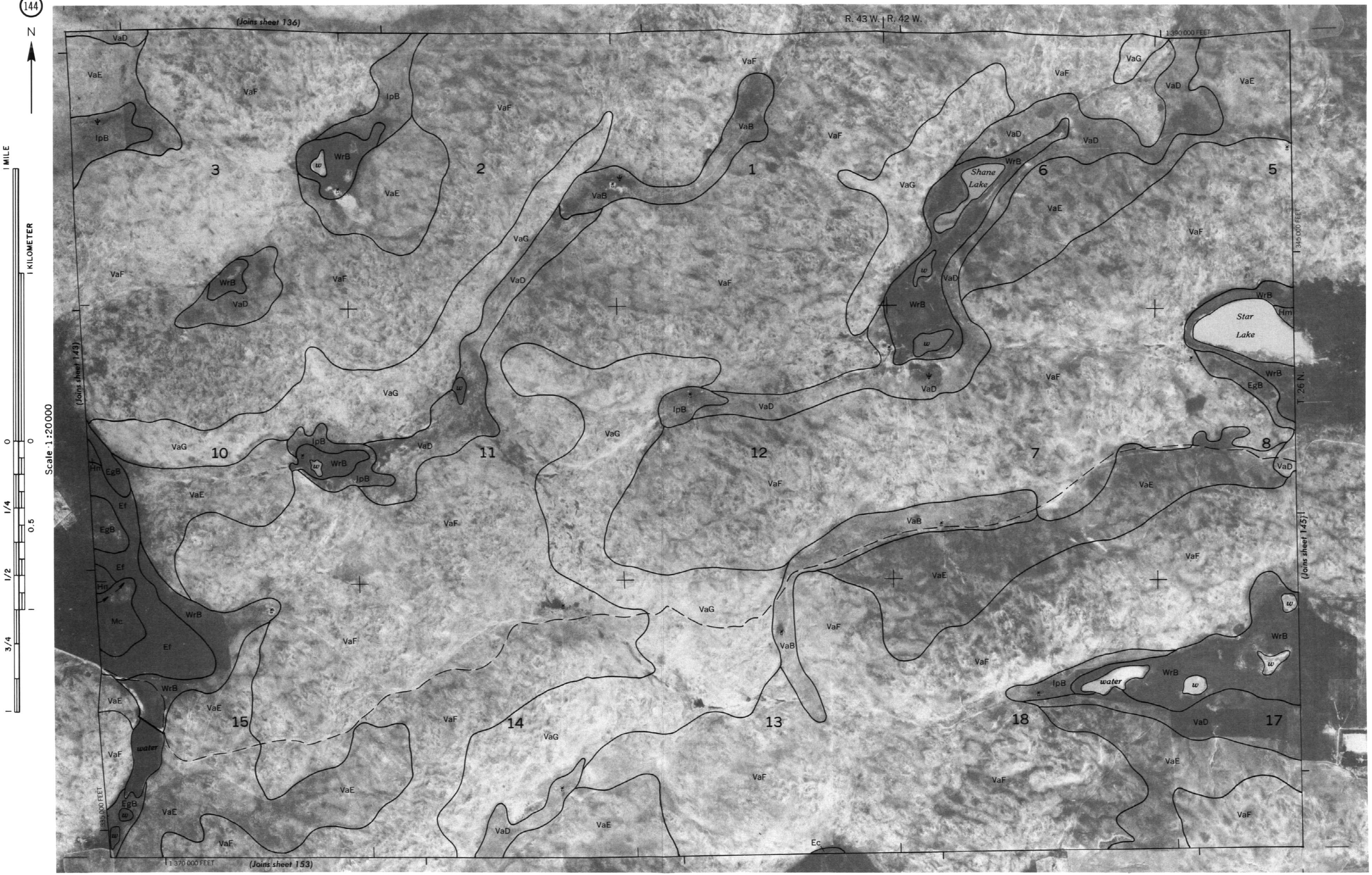
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

143



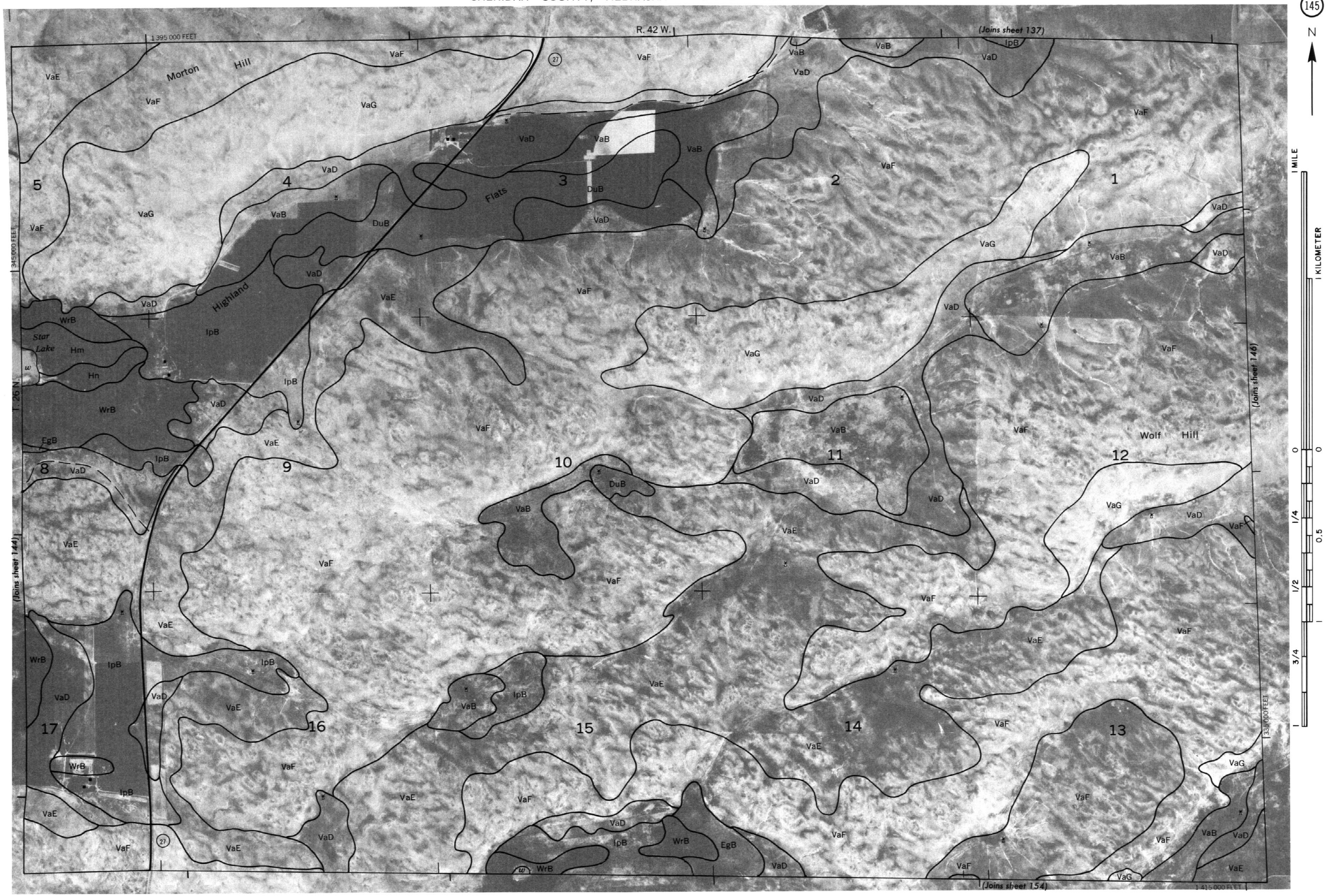
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 143



SHERIDAN COUNTY, NEBRASKA NO. 144

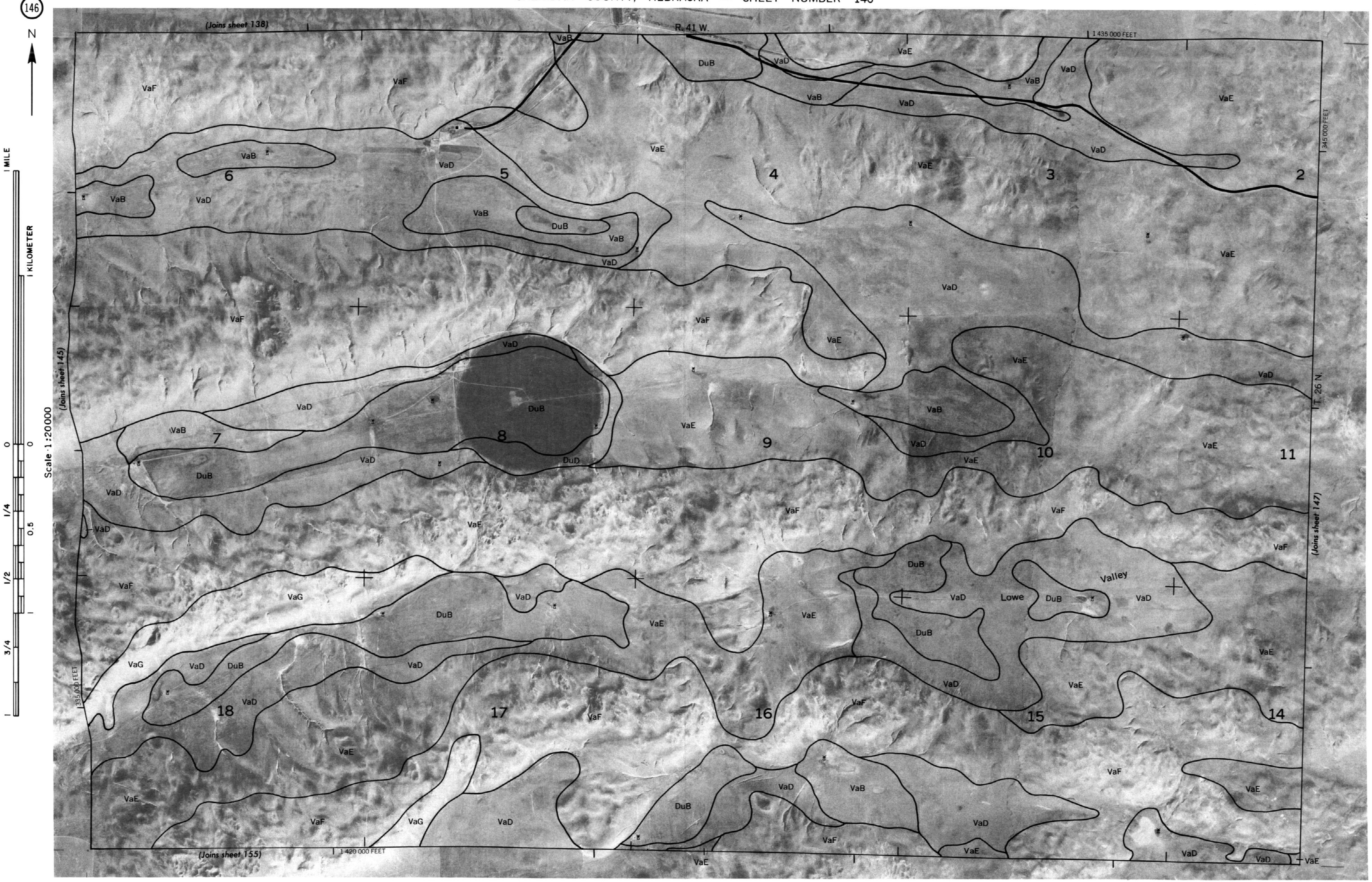
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 145

SHERIDAN COUNTY, NEBRASKA — SHEET NUMBER 146

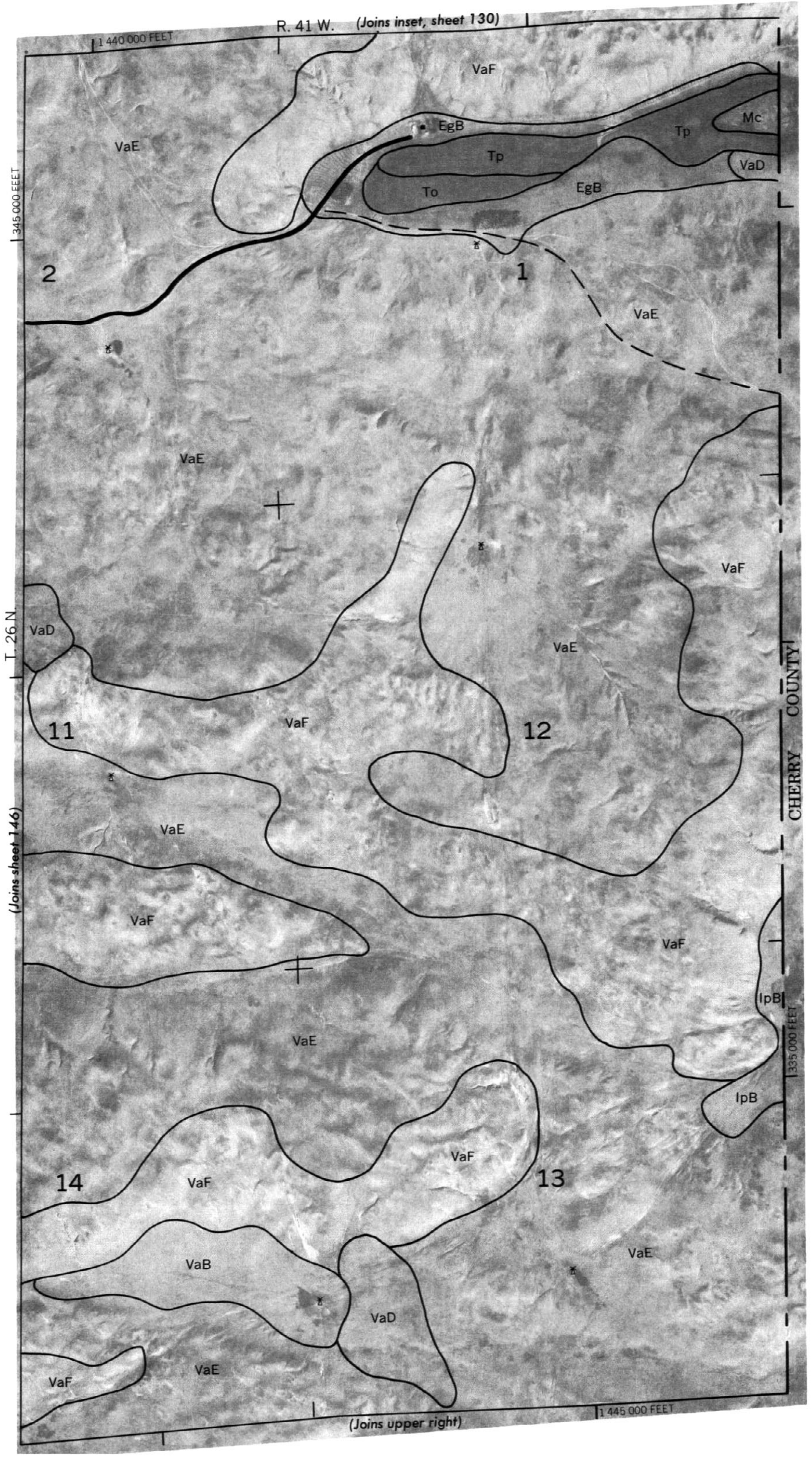


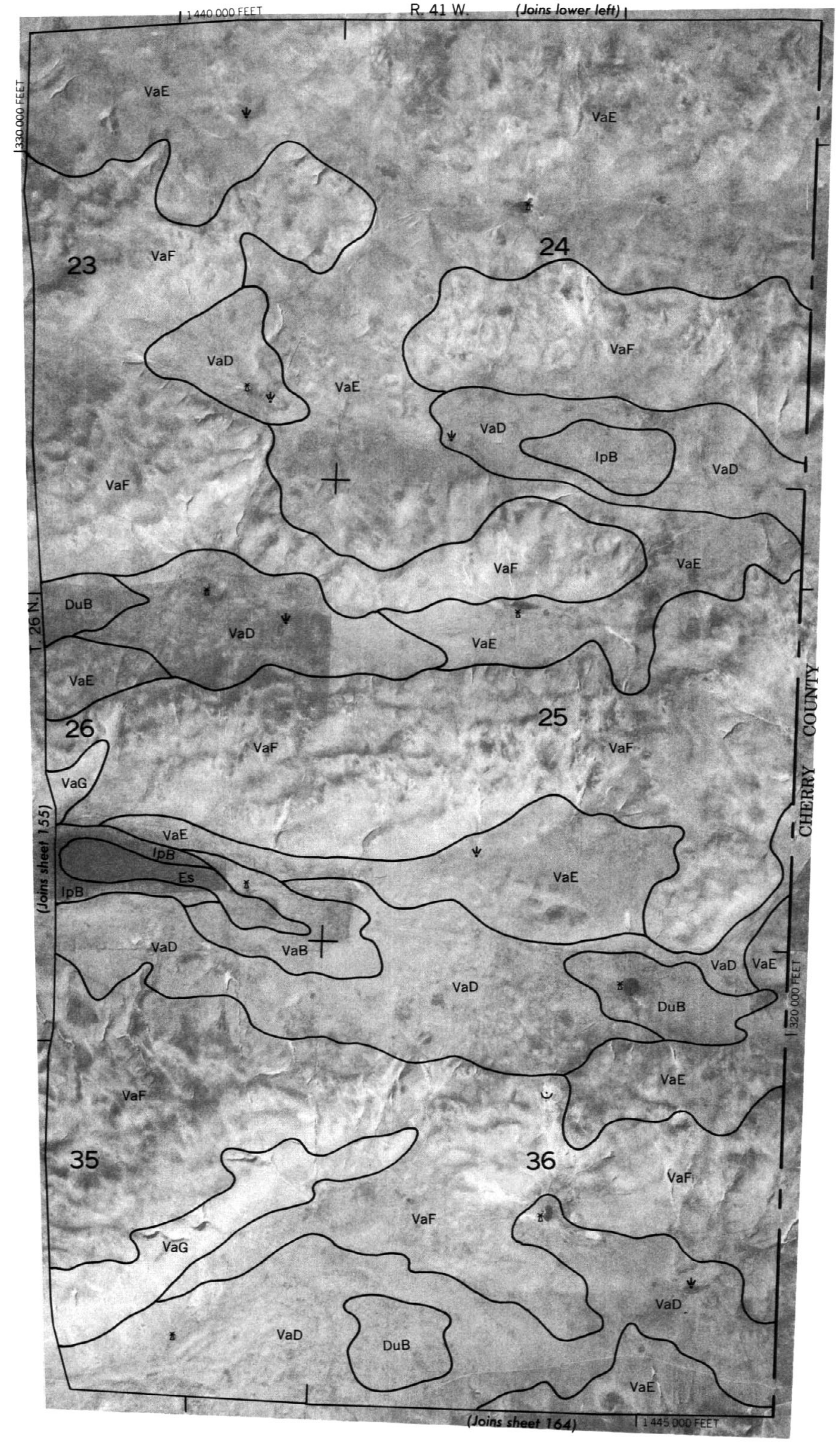
SHERIDAN COUNTY, NEBRASKA NO. 146

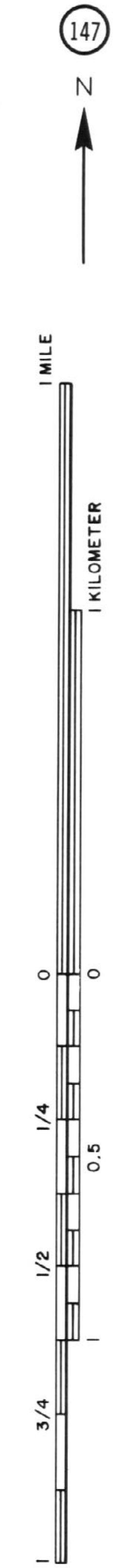
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 147

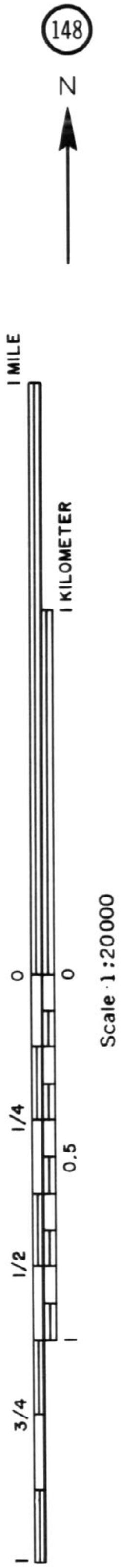


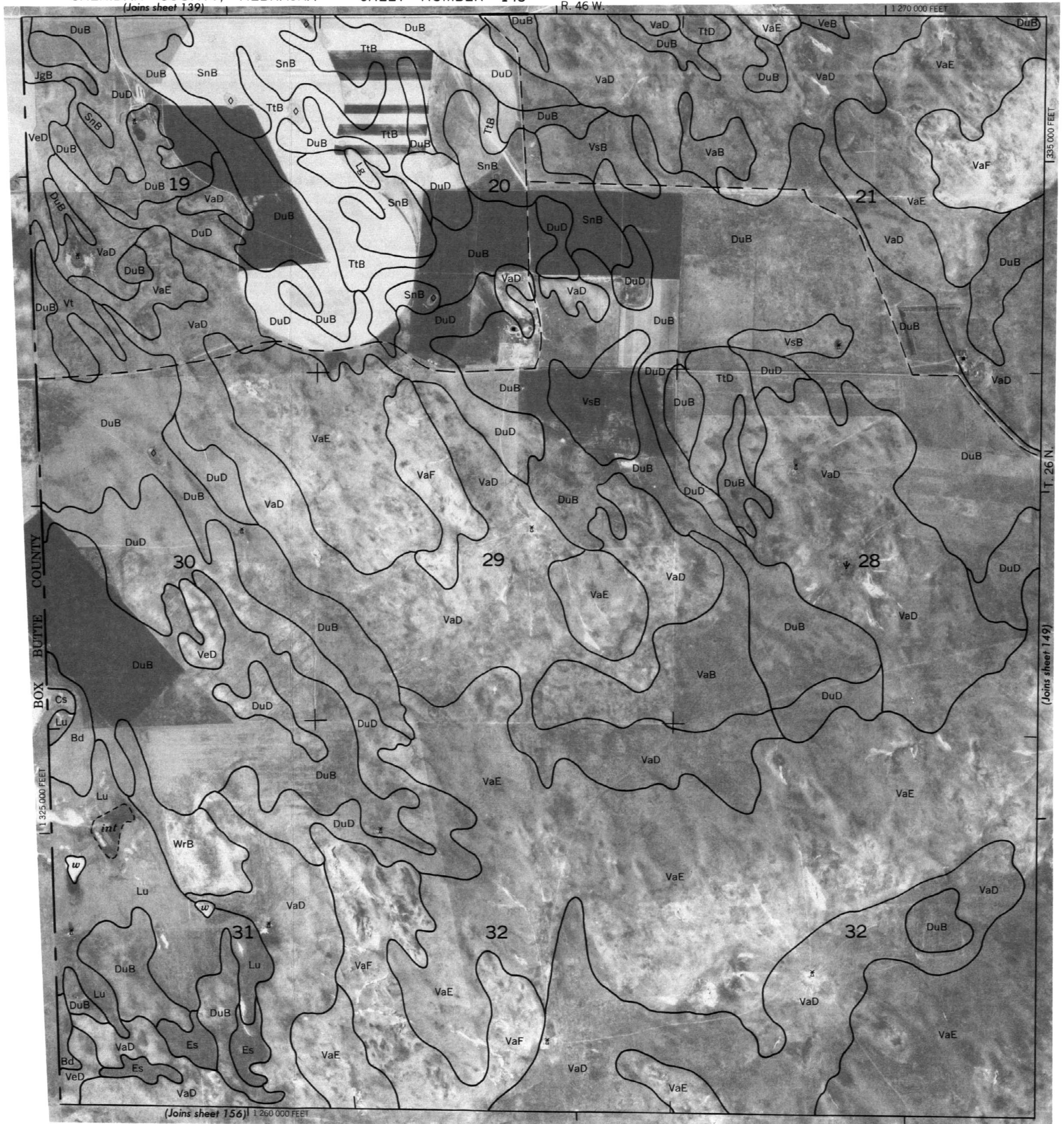




148

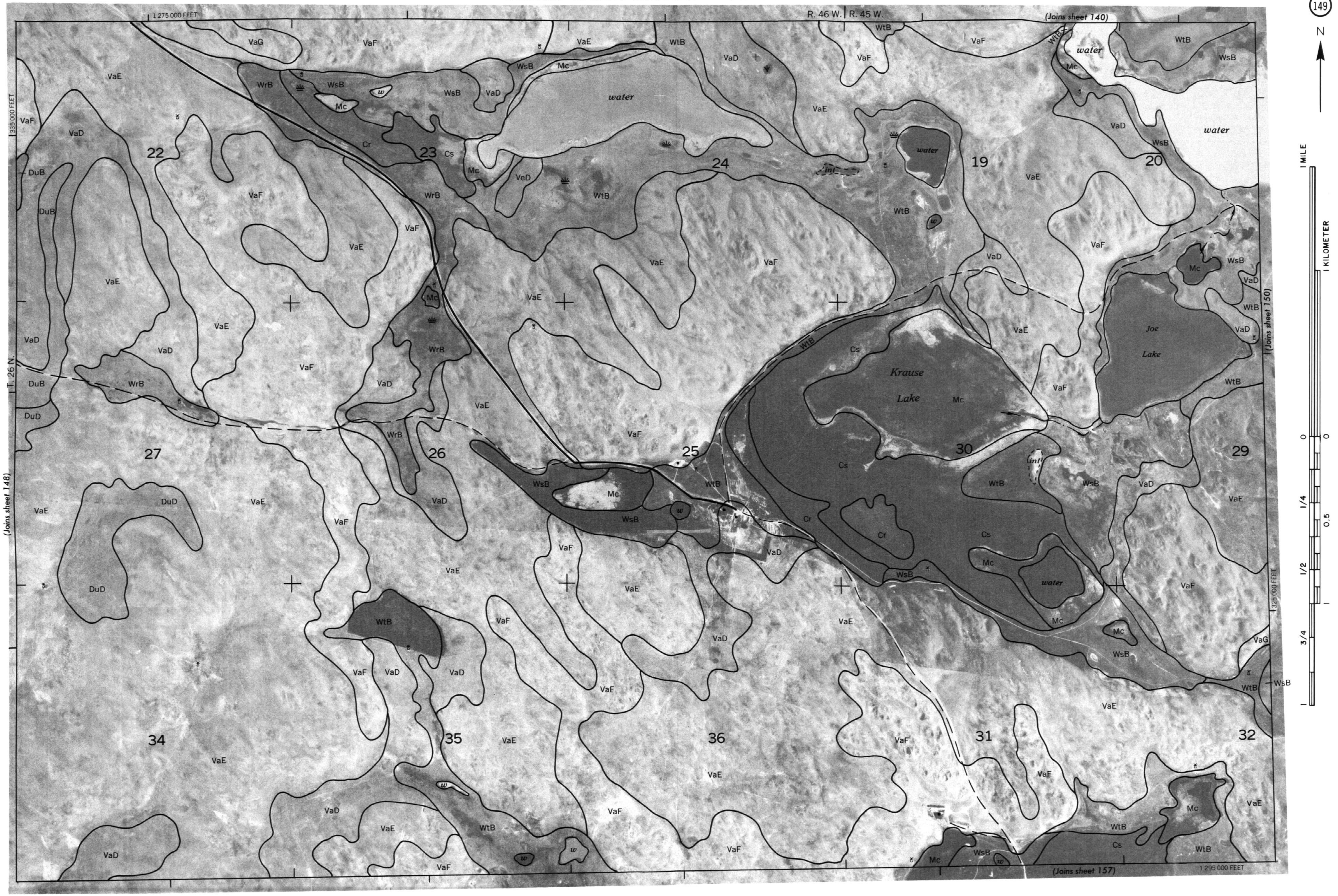
SHERIDAN COUNTY, NEBRASKA — SHEET NUMBER 148





SHERIDAN COUNTY, NEBRASKA NO. 148

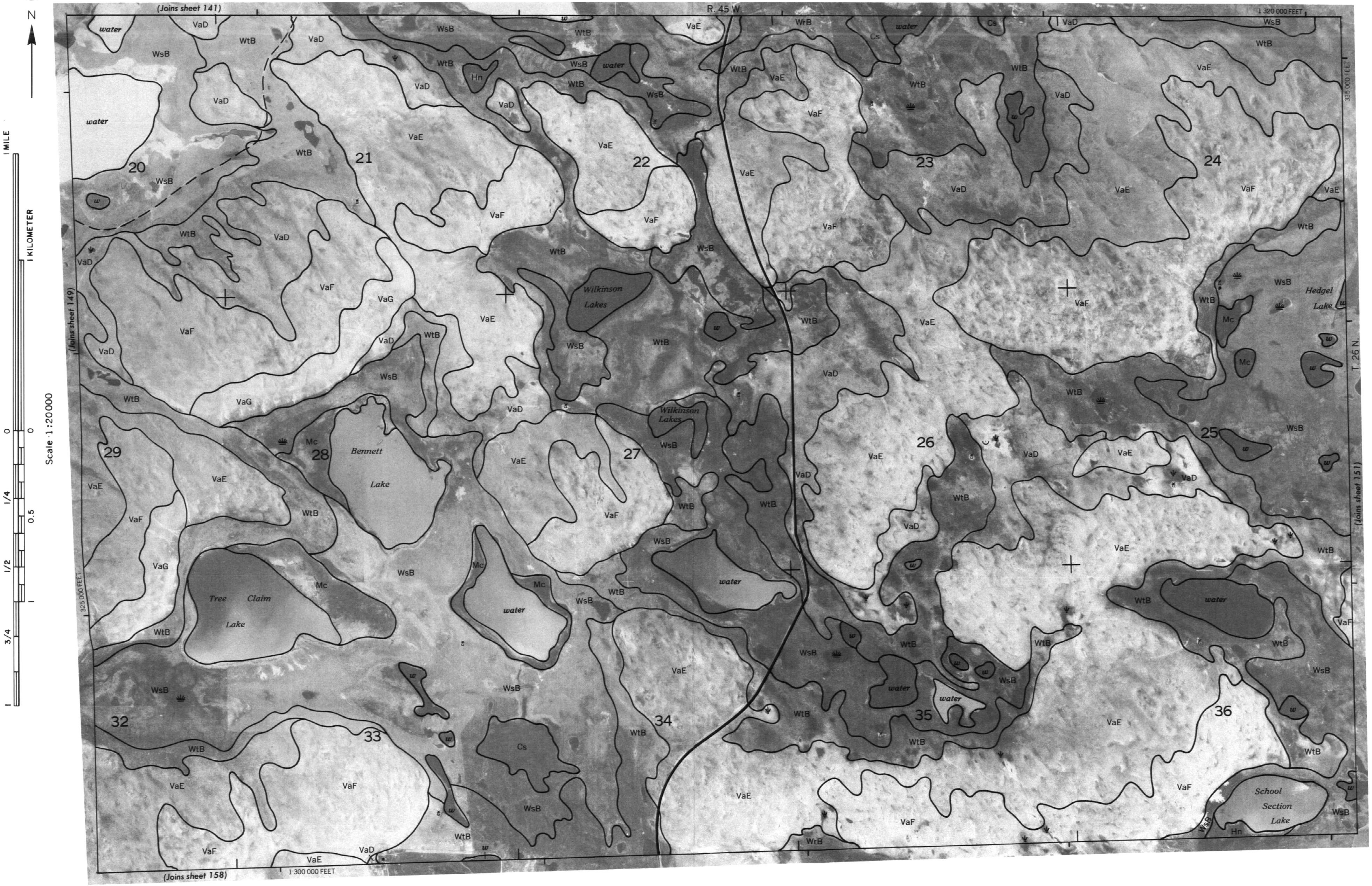
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

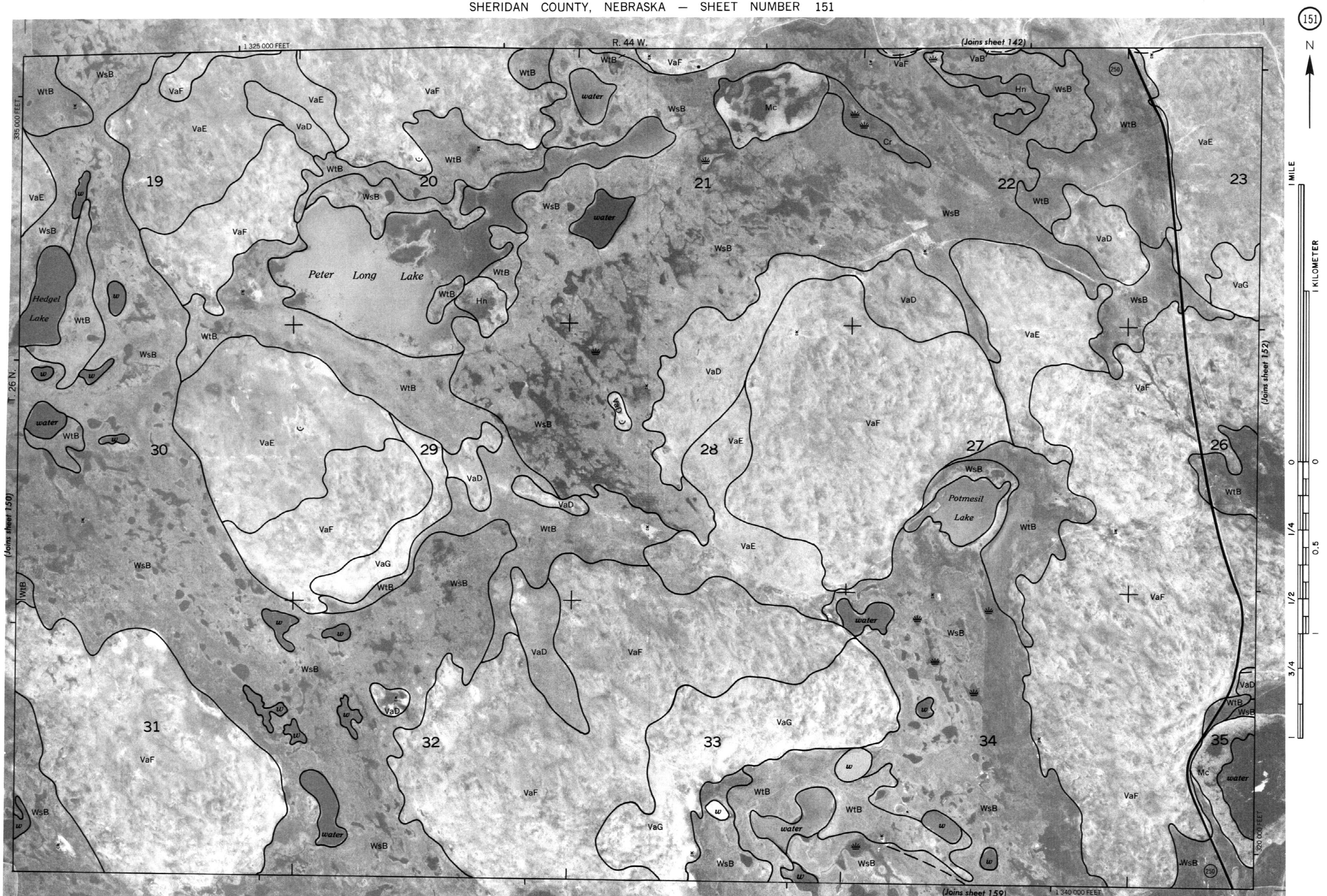
SHERIDAN COUNTY, NEBRASKA NO. 149

SHERIDAN COUNTY, NEBRASKA — SHEET NUMBER 150



SHERIDAN COUNTY, NEBRASKA NO. 150

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 151

N

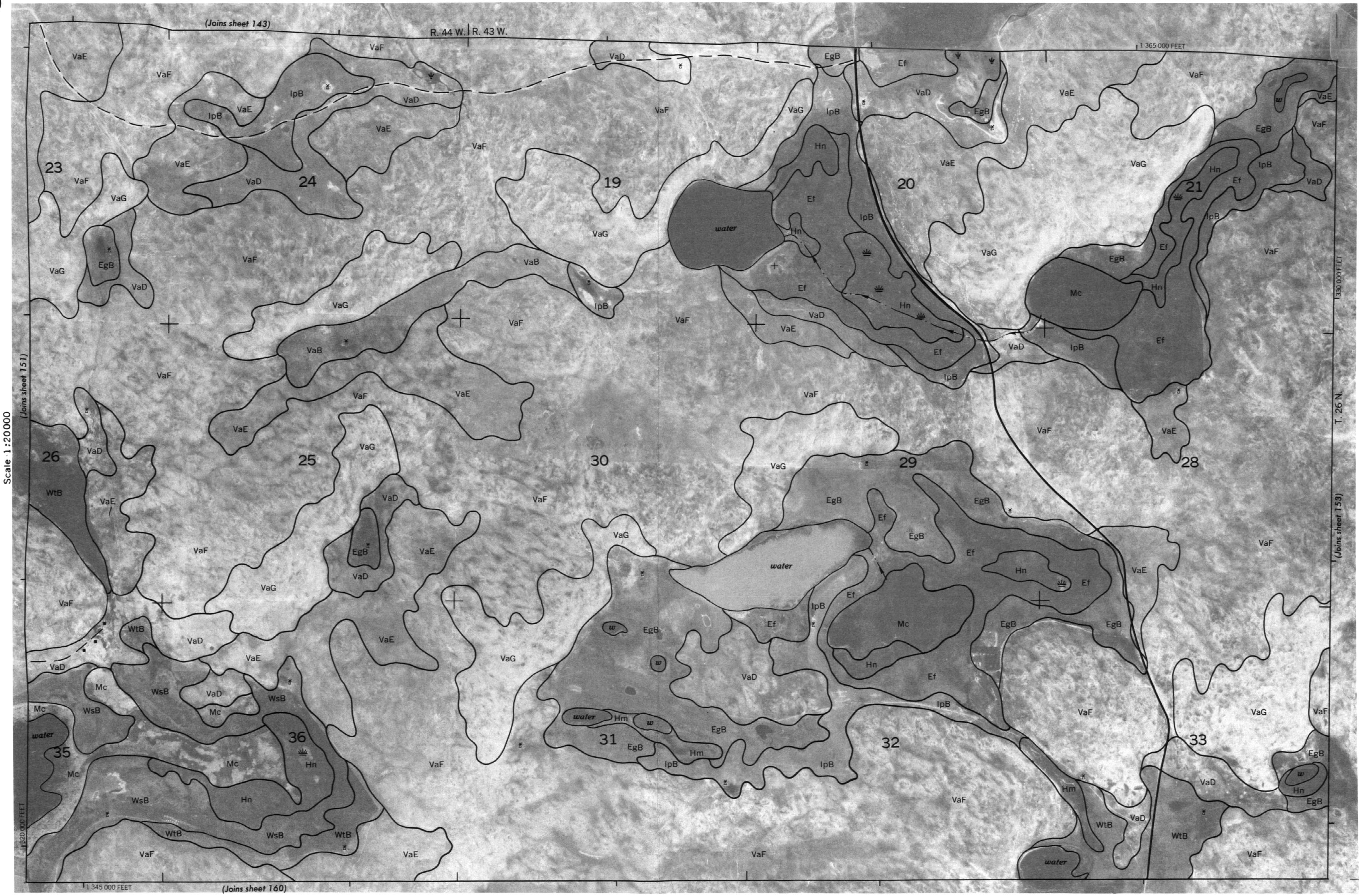
1 MILE

1 KILOMETER

Scale 1:20000

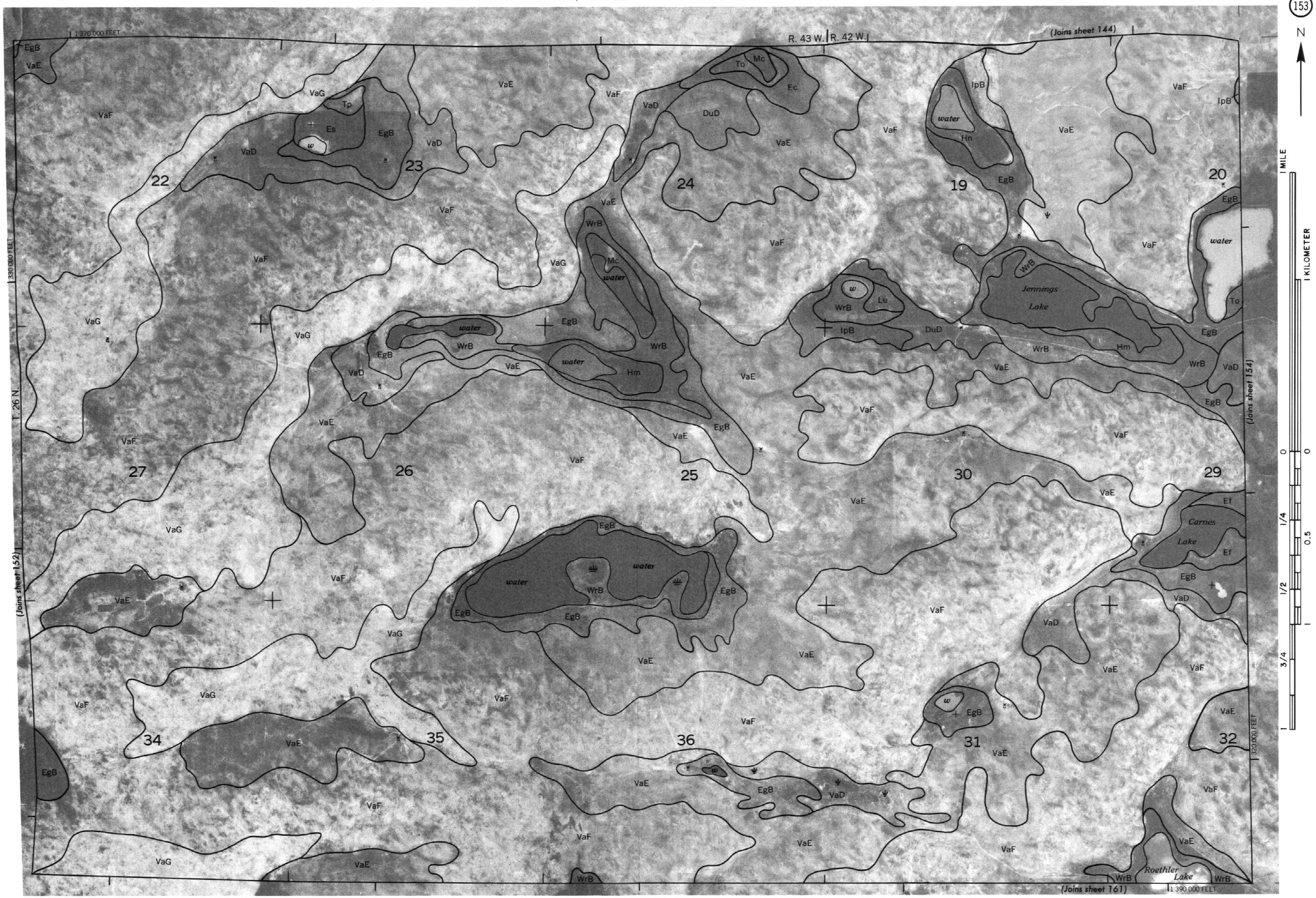
0 1/4 1/2 3/4 1

0 0.5 1



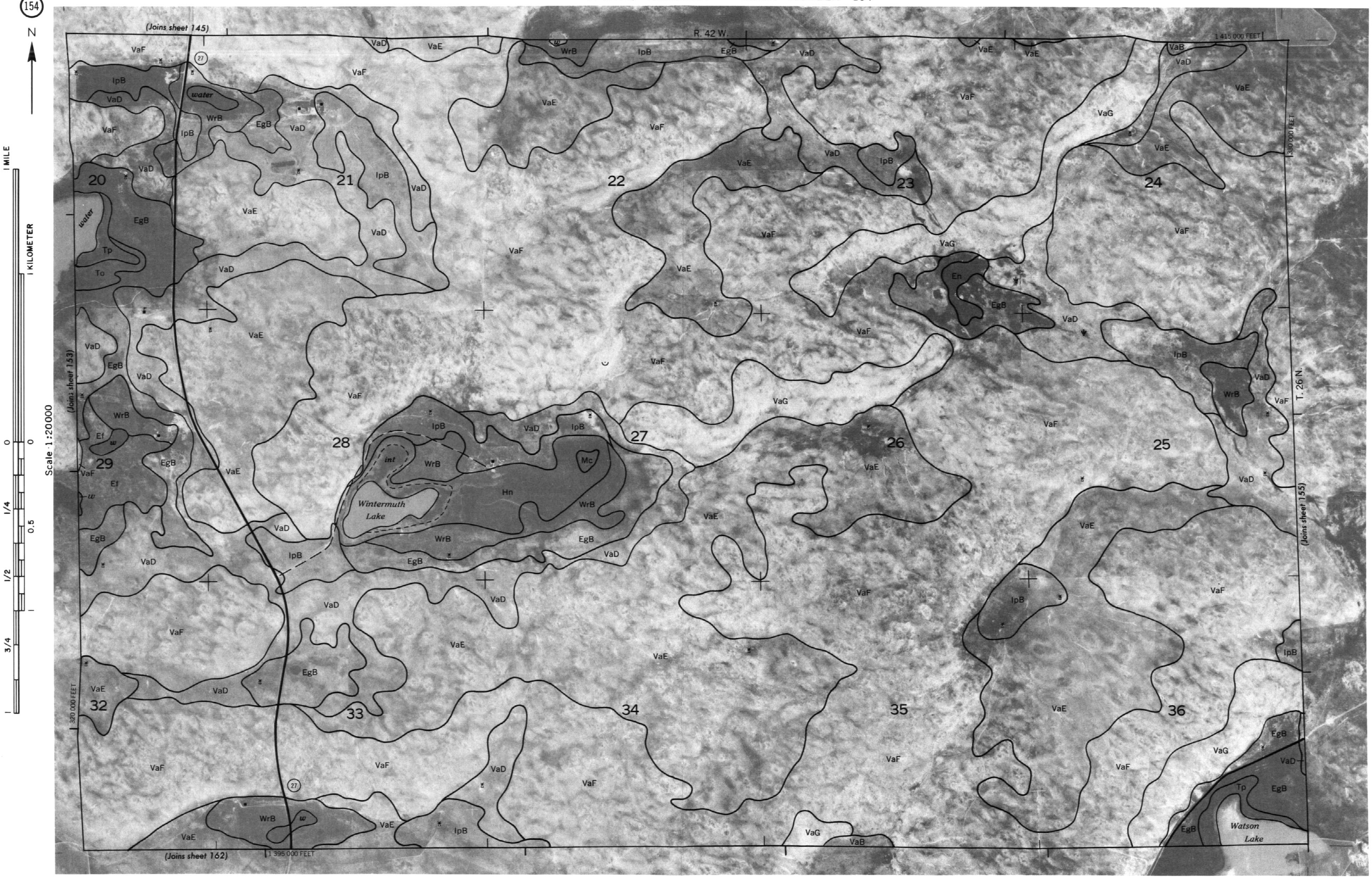
SHERIDAN COUNTY, NEBRASKA NO. 152

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



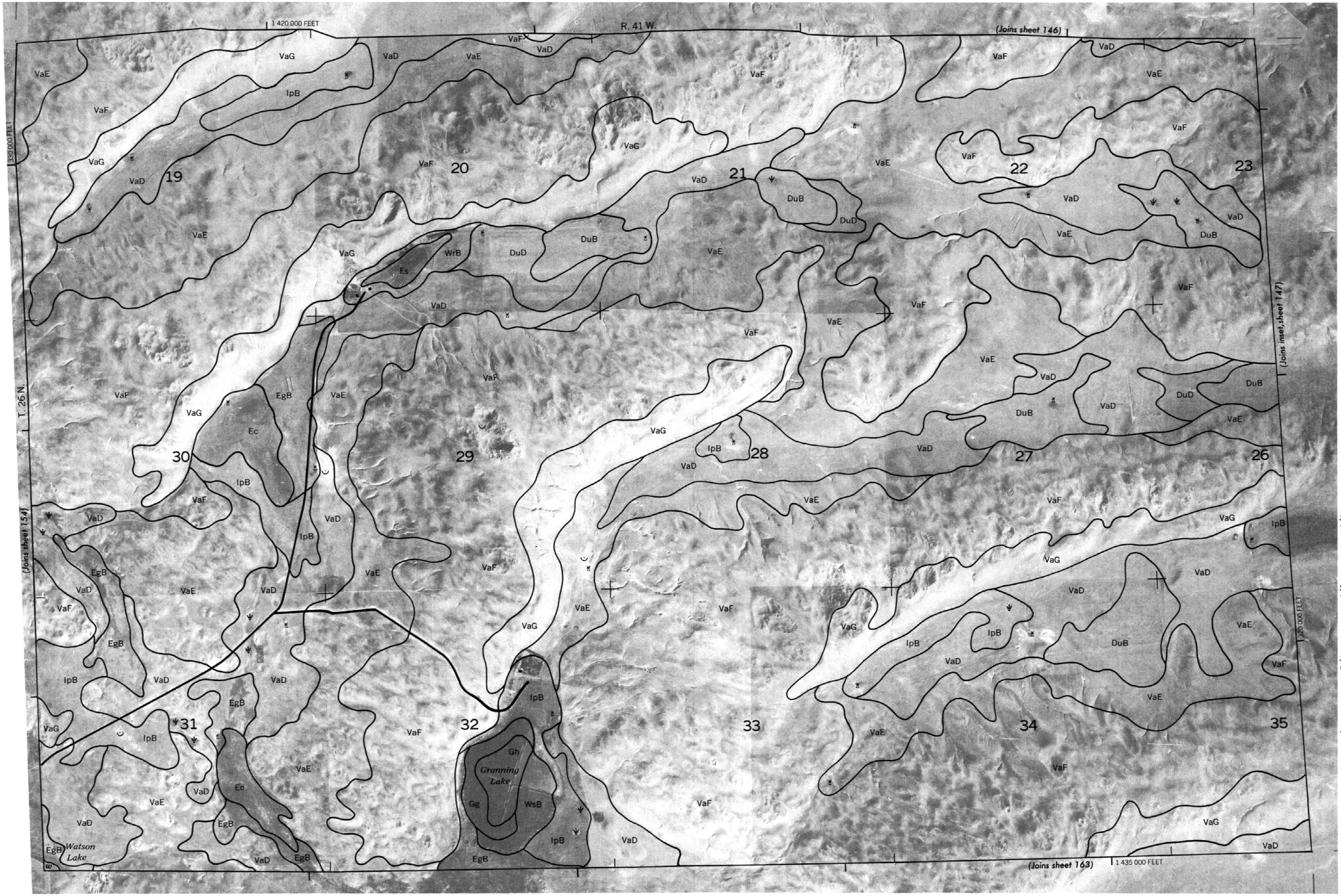
Scale 1:20000

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



SHERIDAN COUNTY, NEBRASKA NO. 154

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

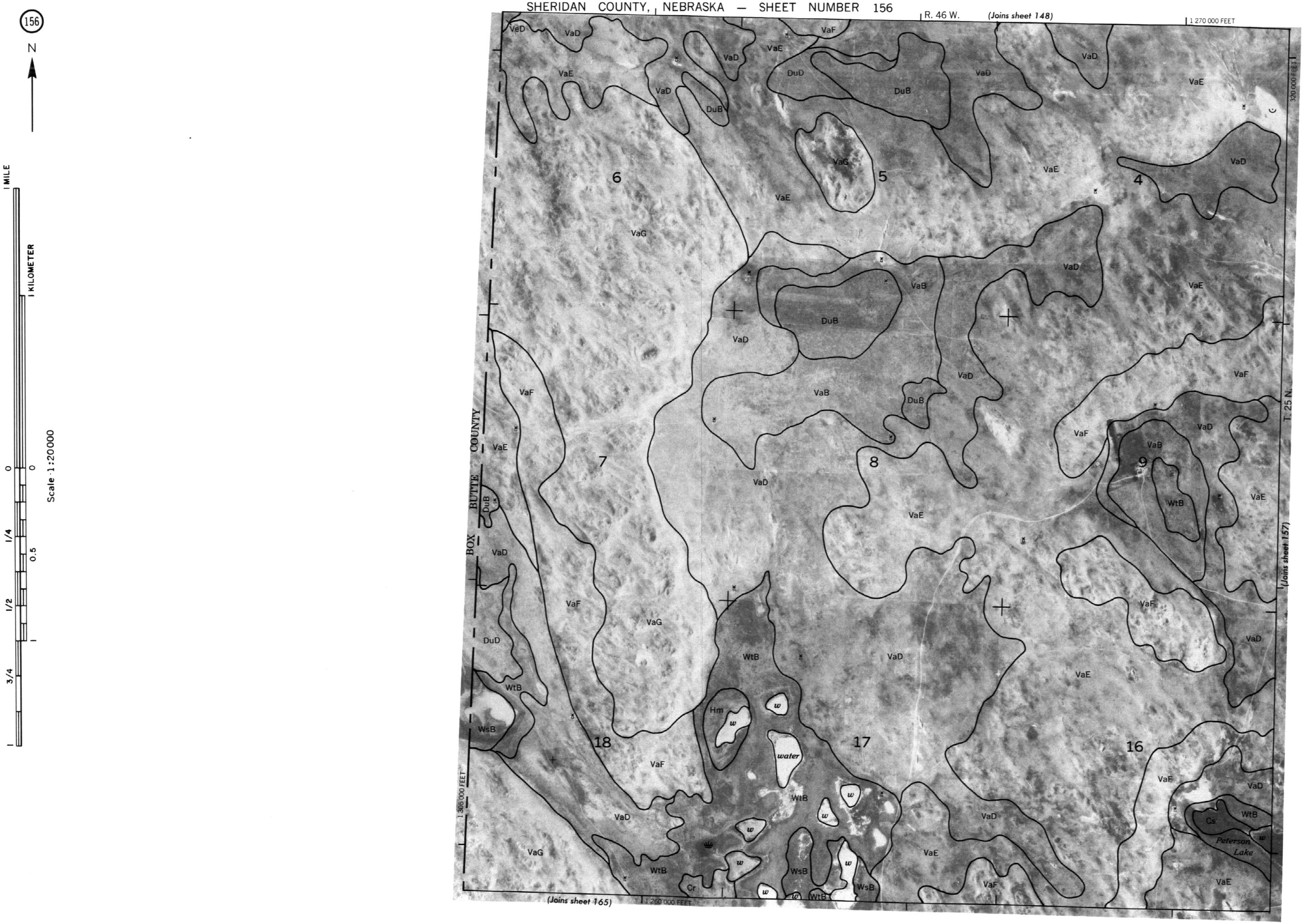


N

1 MILE
1 KILOMETER
0
1/4
1/2
3/4
0
0.5
Scale 1:20000

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA — SHEET NUMBER 156



SHERIDAN COUNTY, NEBRASKA NO. 156

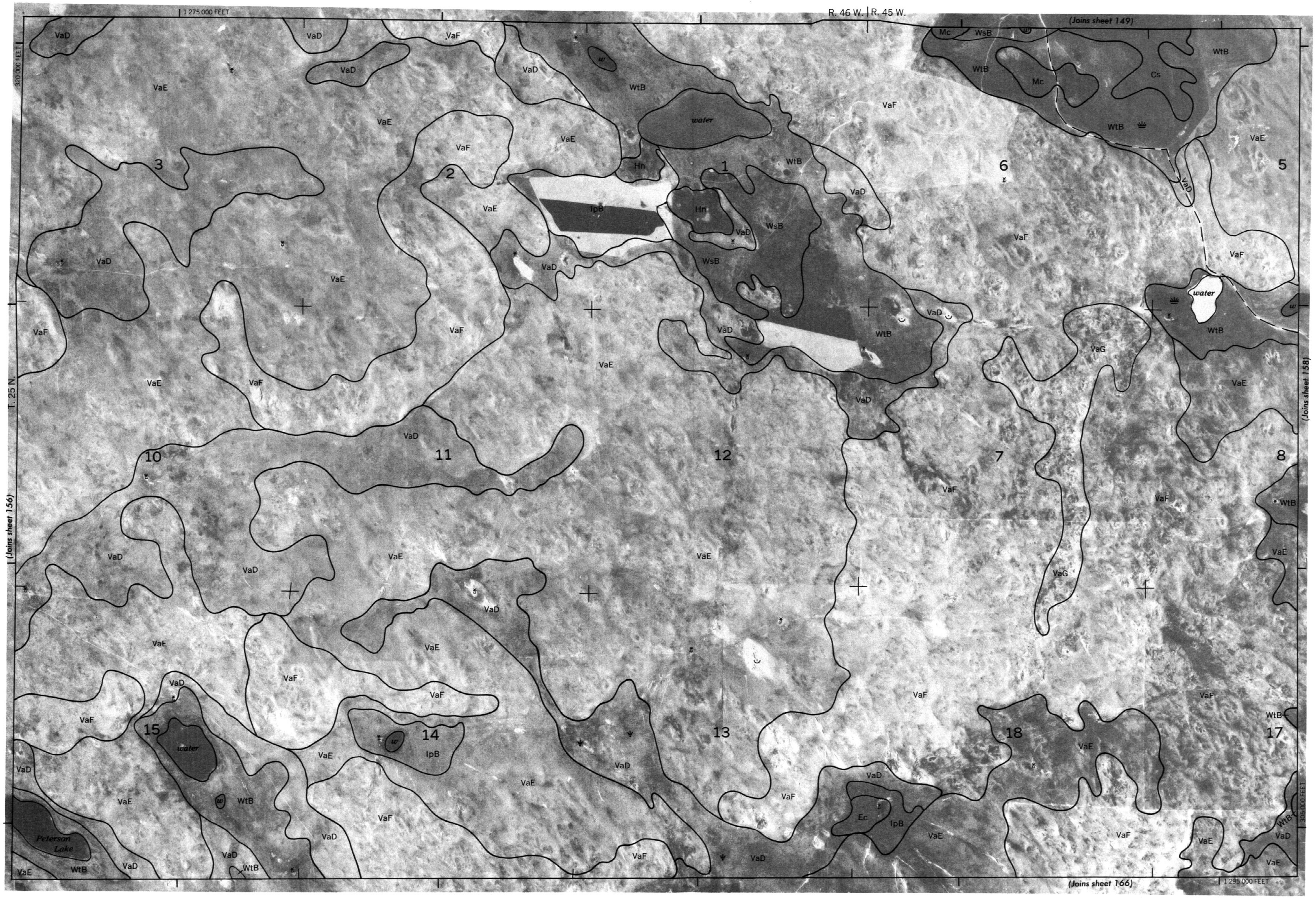
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(157)

N

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 157



1 MILE

1 KILOMETER

0

1/4

1/2

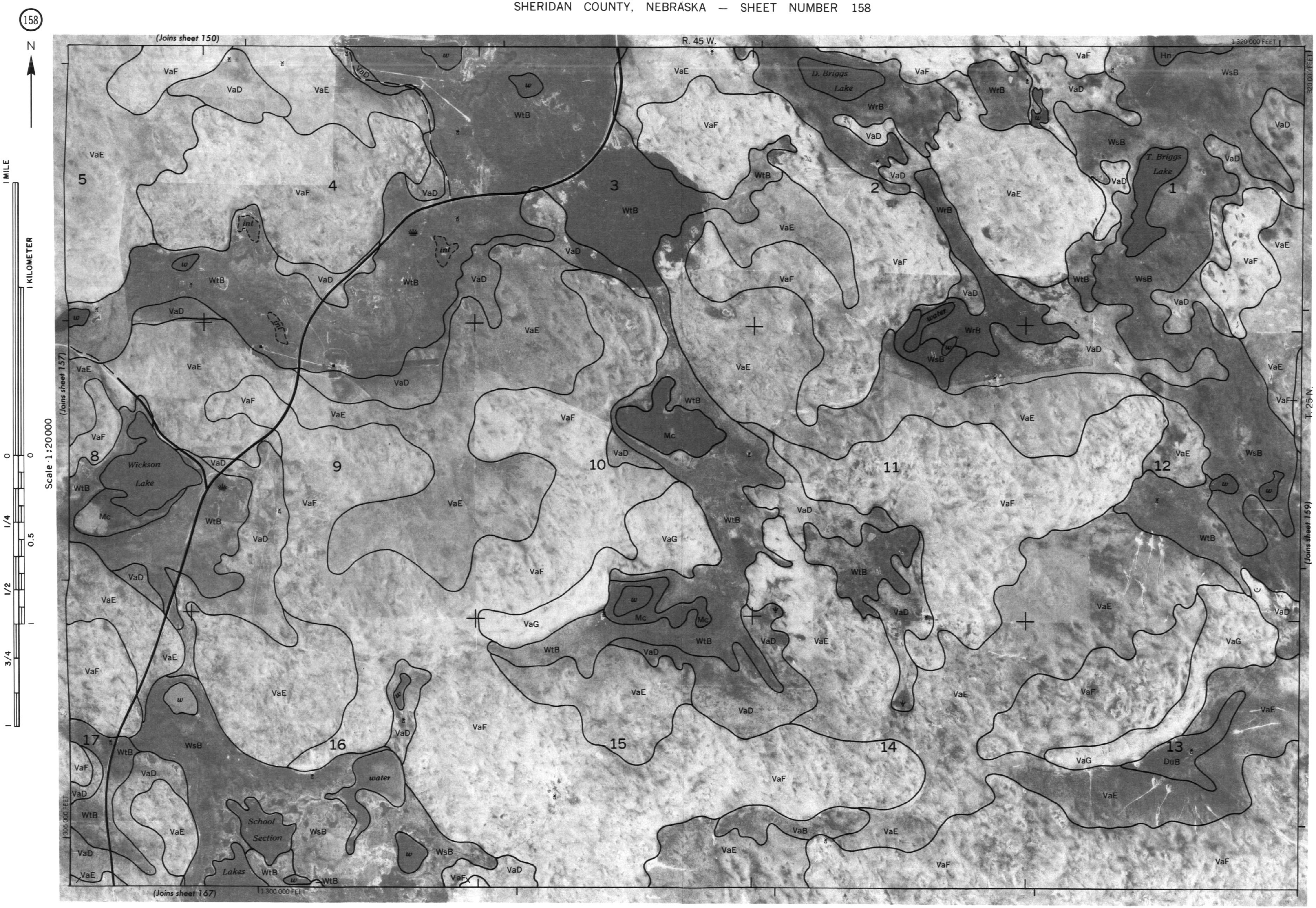
3/4

1

0

0.5

Scale 1:20000

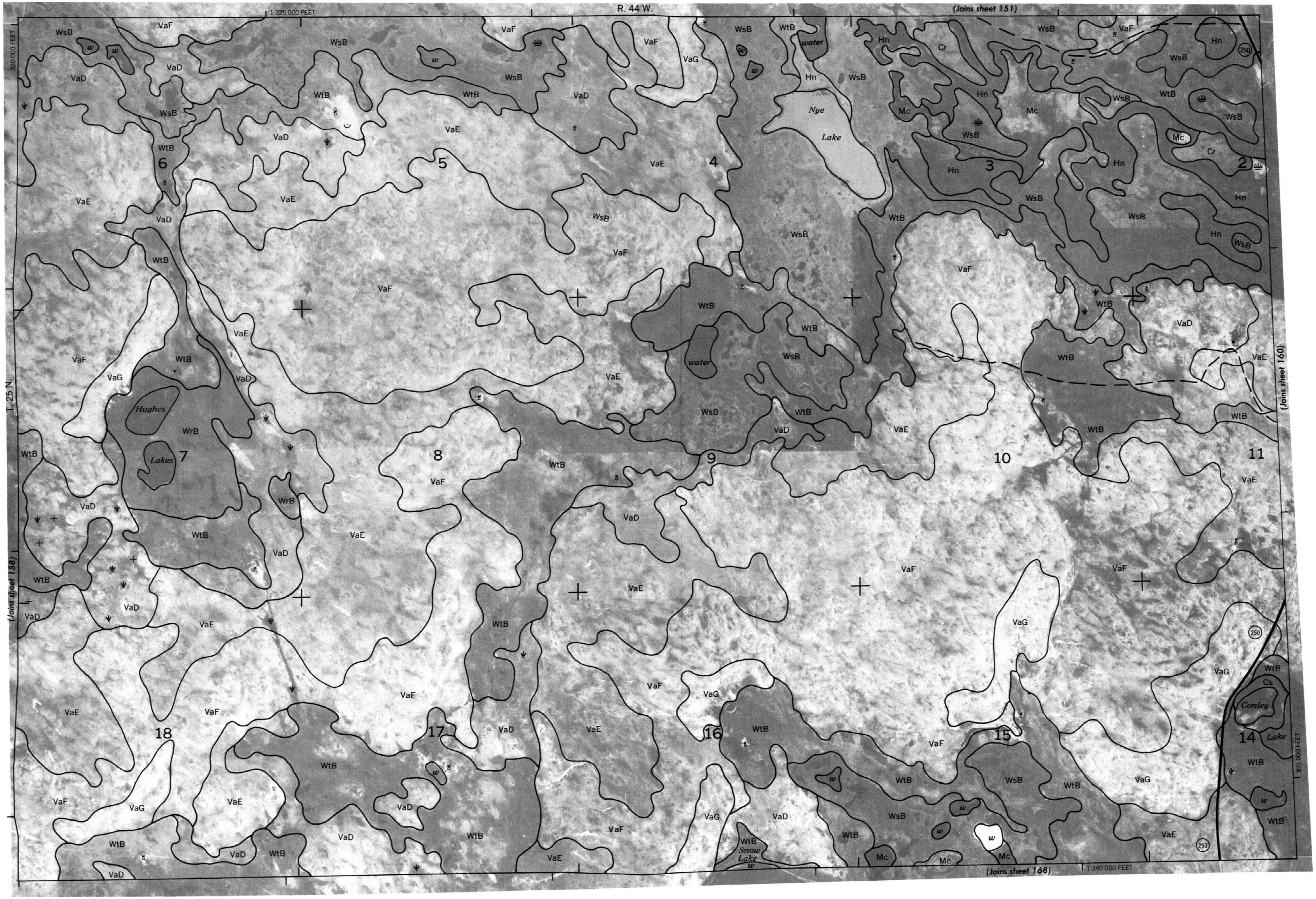


SHERIDAN COUNTY, NEBRASKA NO. 158

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 159

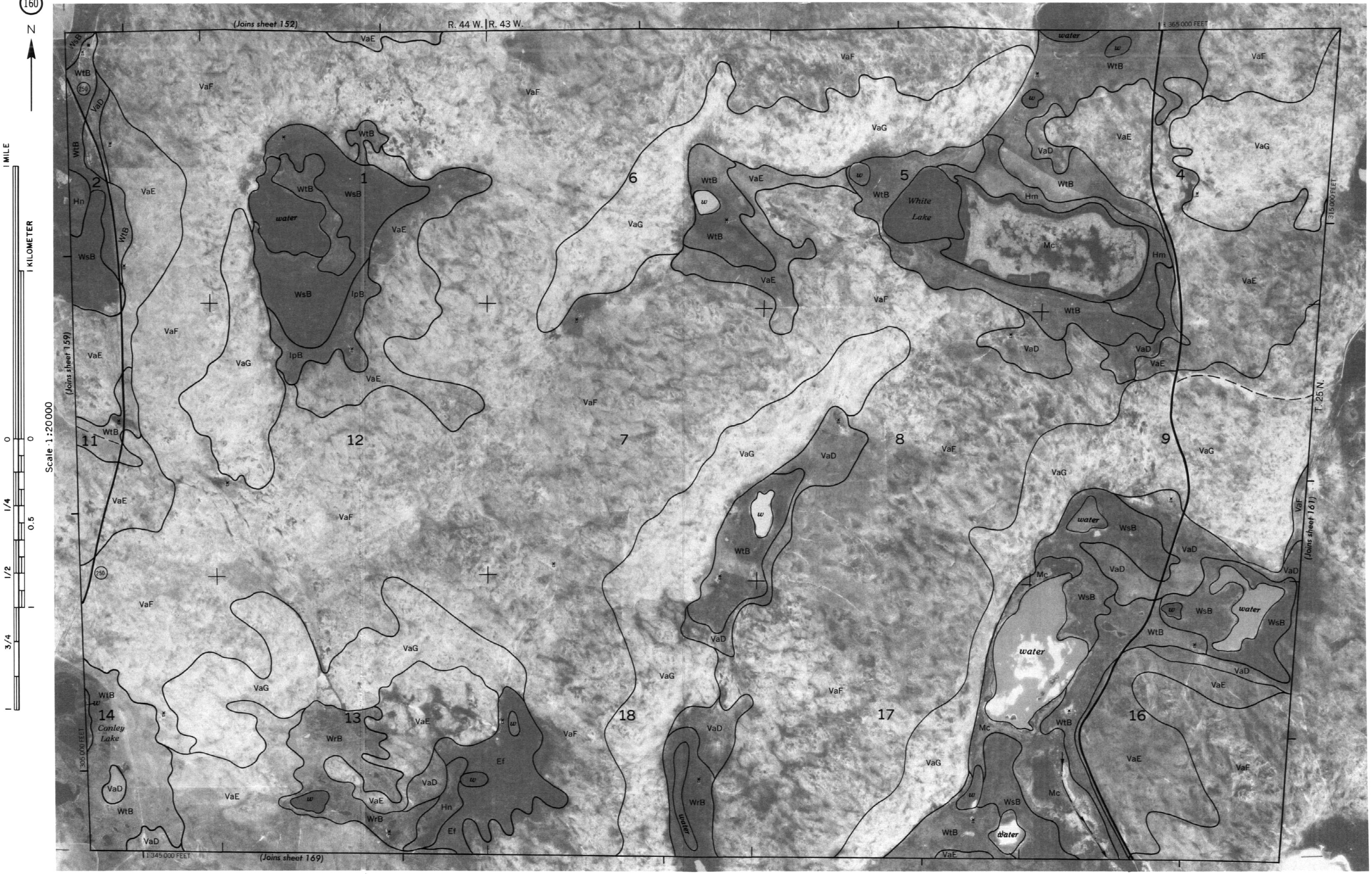


159

N

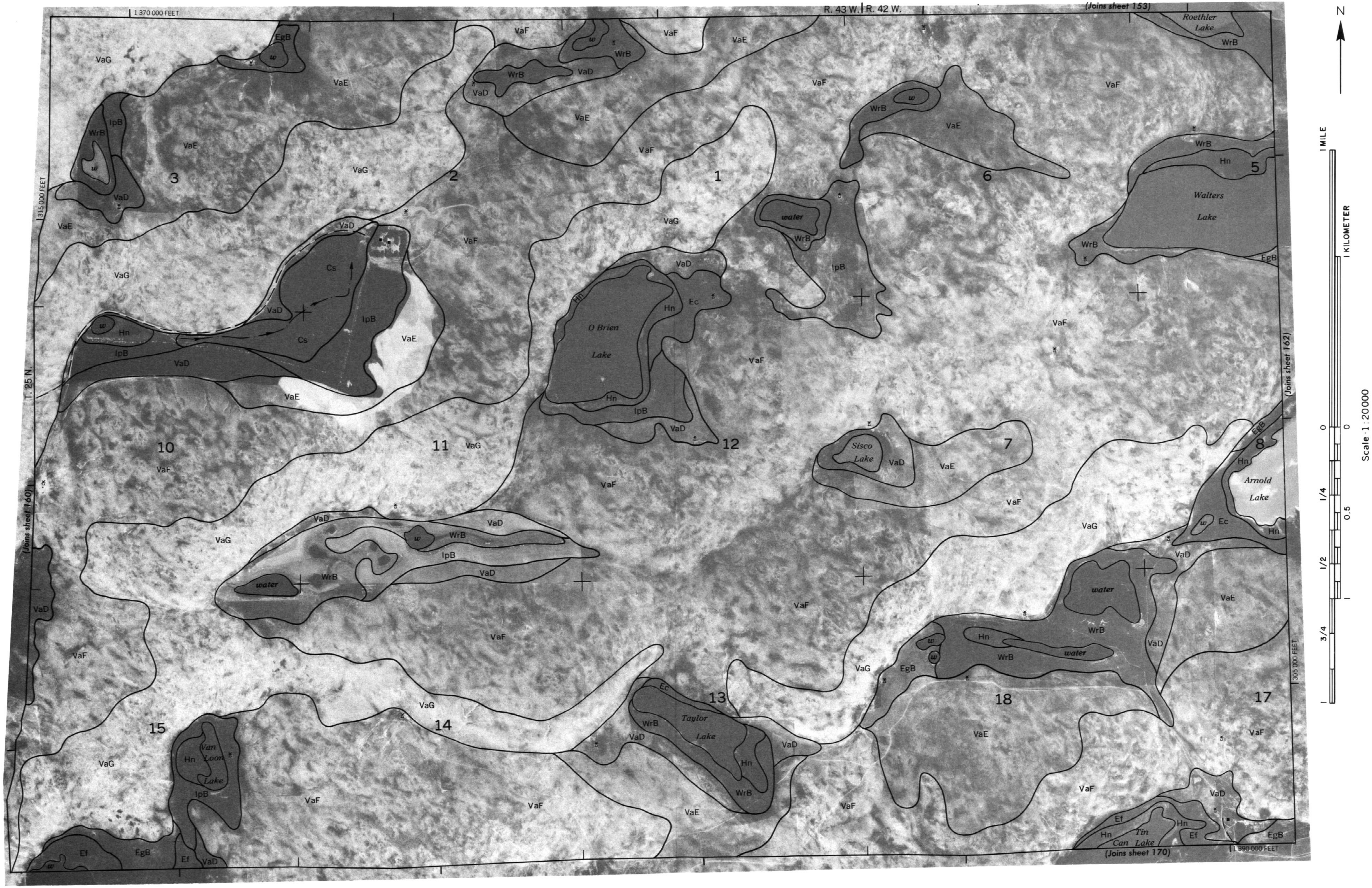
1 MILE
1 KILOMETER
0 1/4 1/2 3/4
0 0.5
Scale 1:20000

160



SHERIDAN COUNTY, NEBRASKA NO. 160

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

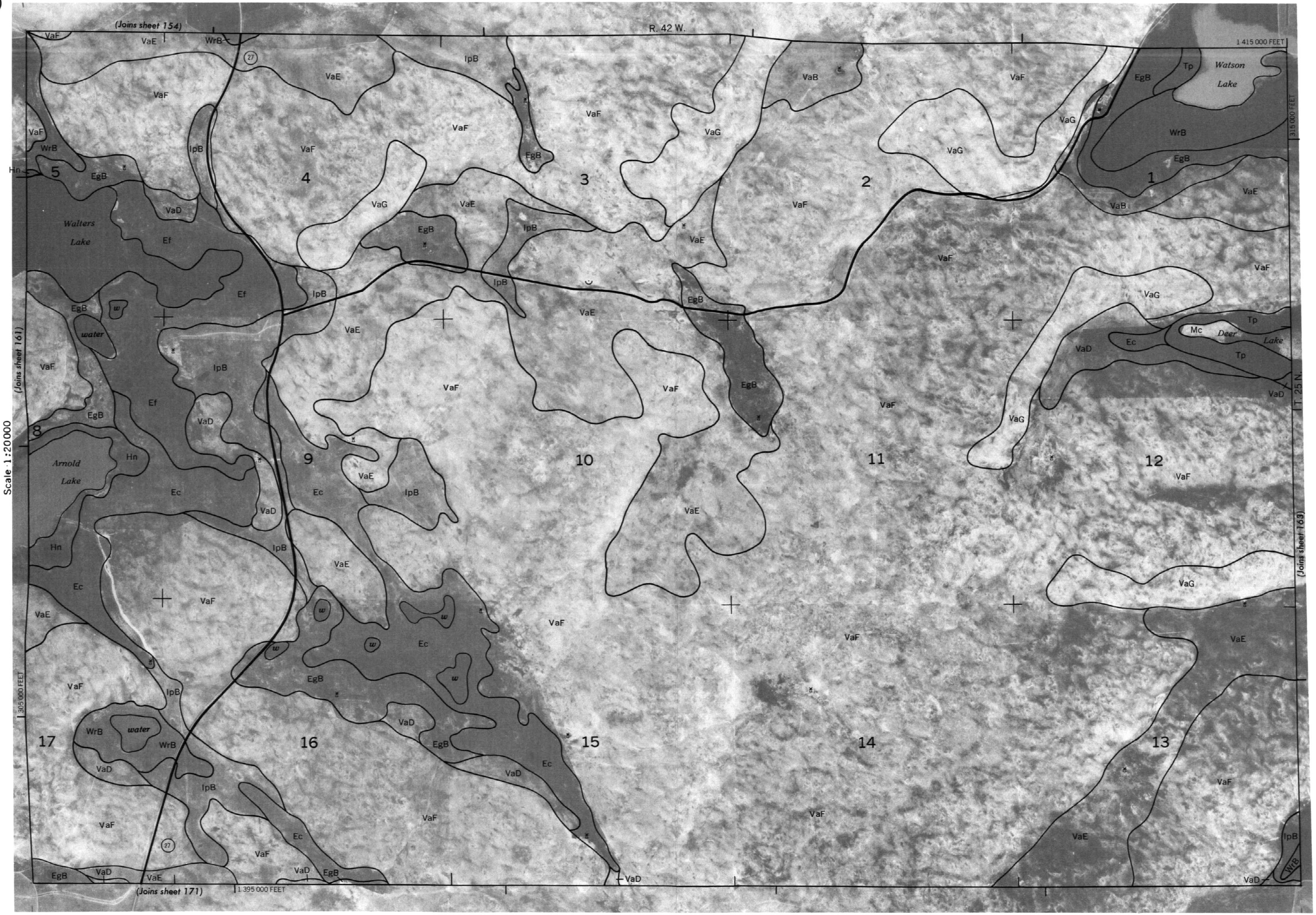


This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 161

162

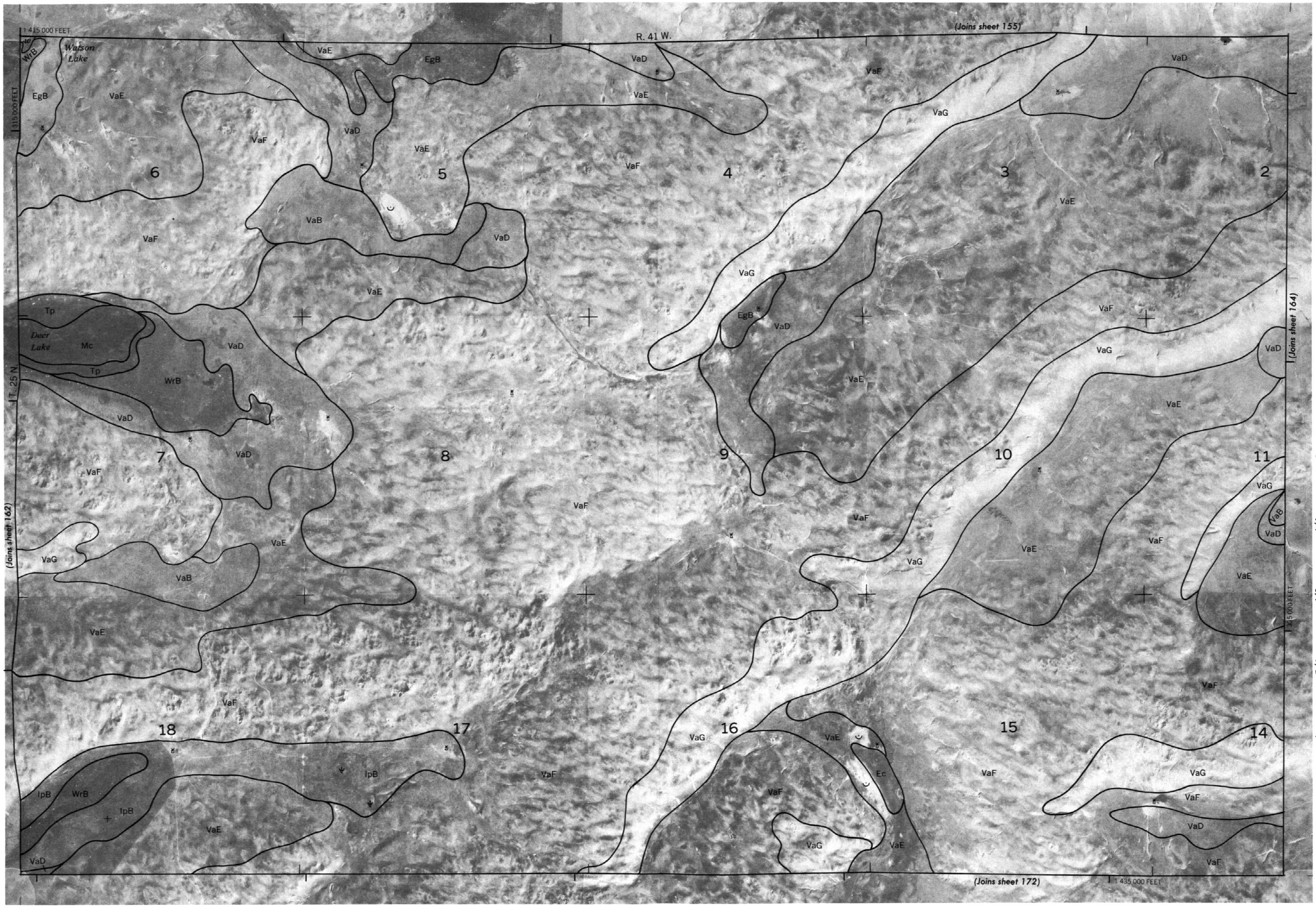
N



1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1

SHERIDAN COUNTY, NEBRASKA NO. 162

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



N

1 MILE

1 KILOMETER

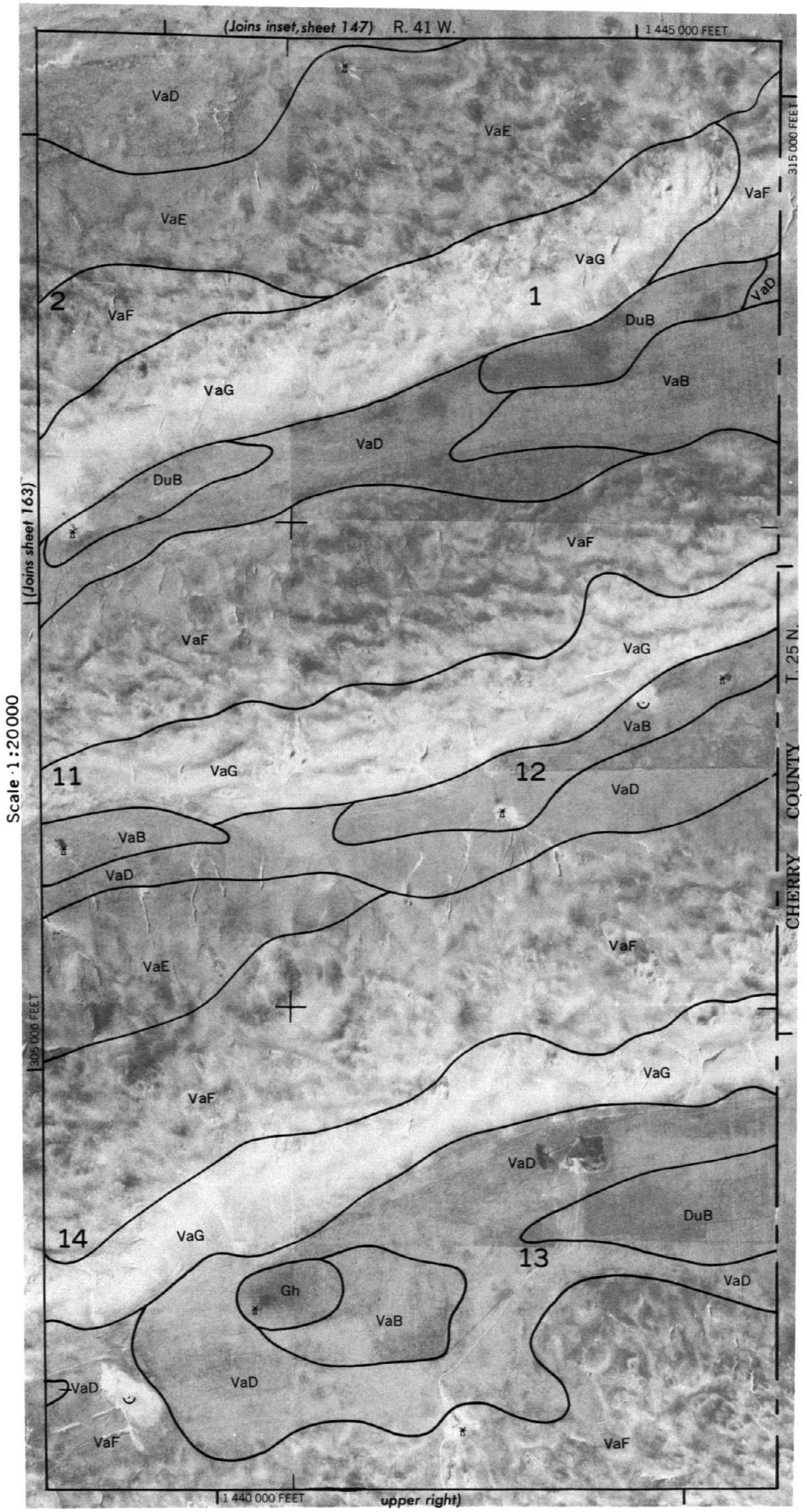
Scale 1:20000

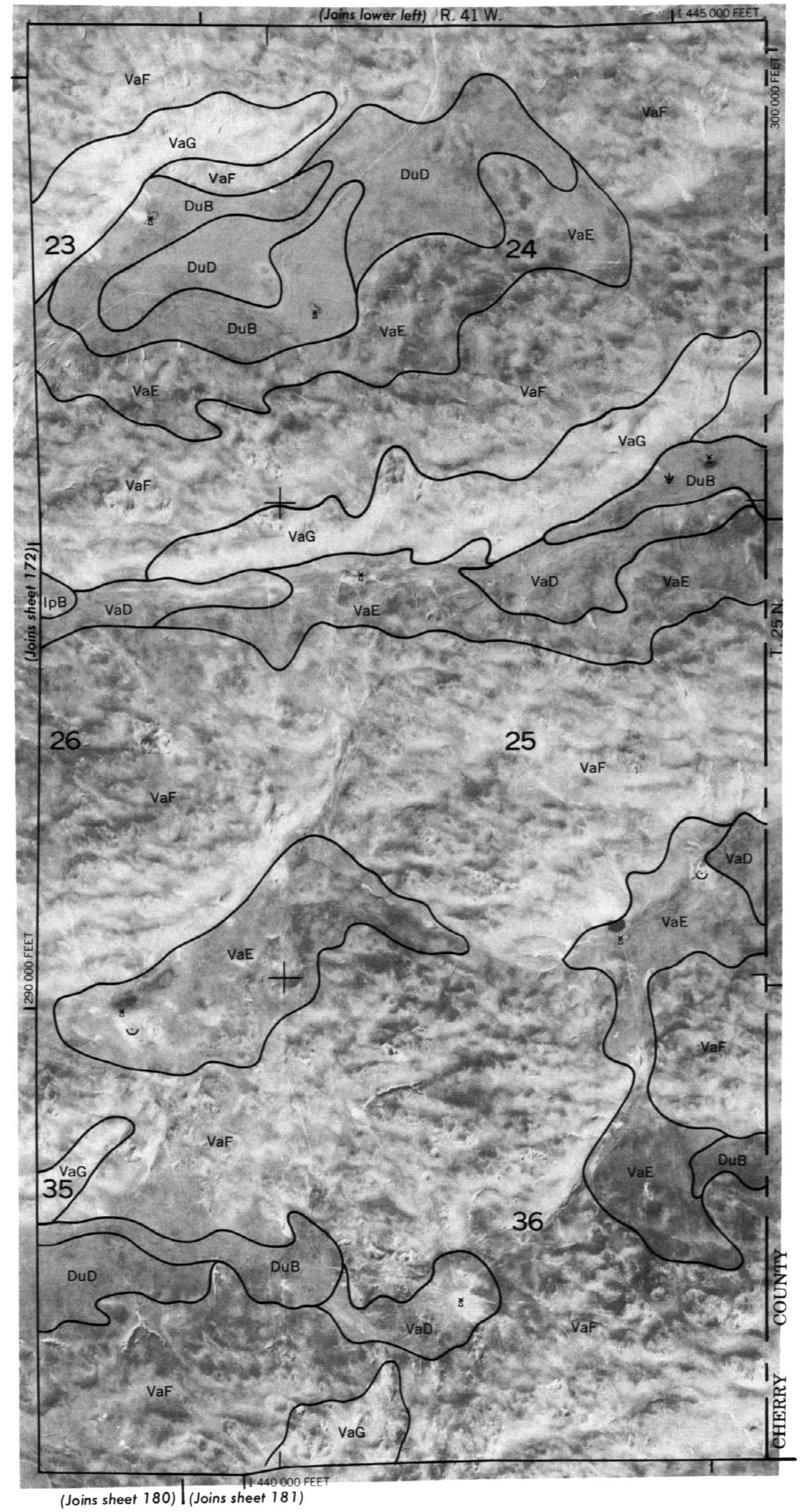
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 163

N

1 MILE
1 KILOMETER
0 1/4 1/2 3/4 1
0 0.5 1
Scale 1:20000





SHERIDAN COUNTY, NEBRASKA NO. 164

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 165

N

1 MILE

1 KILOMETER

0 1/4 1/2 3/4 1

0 0.5 1

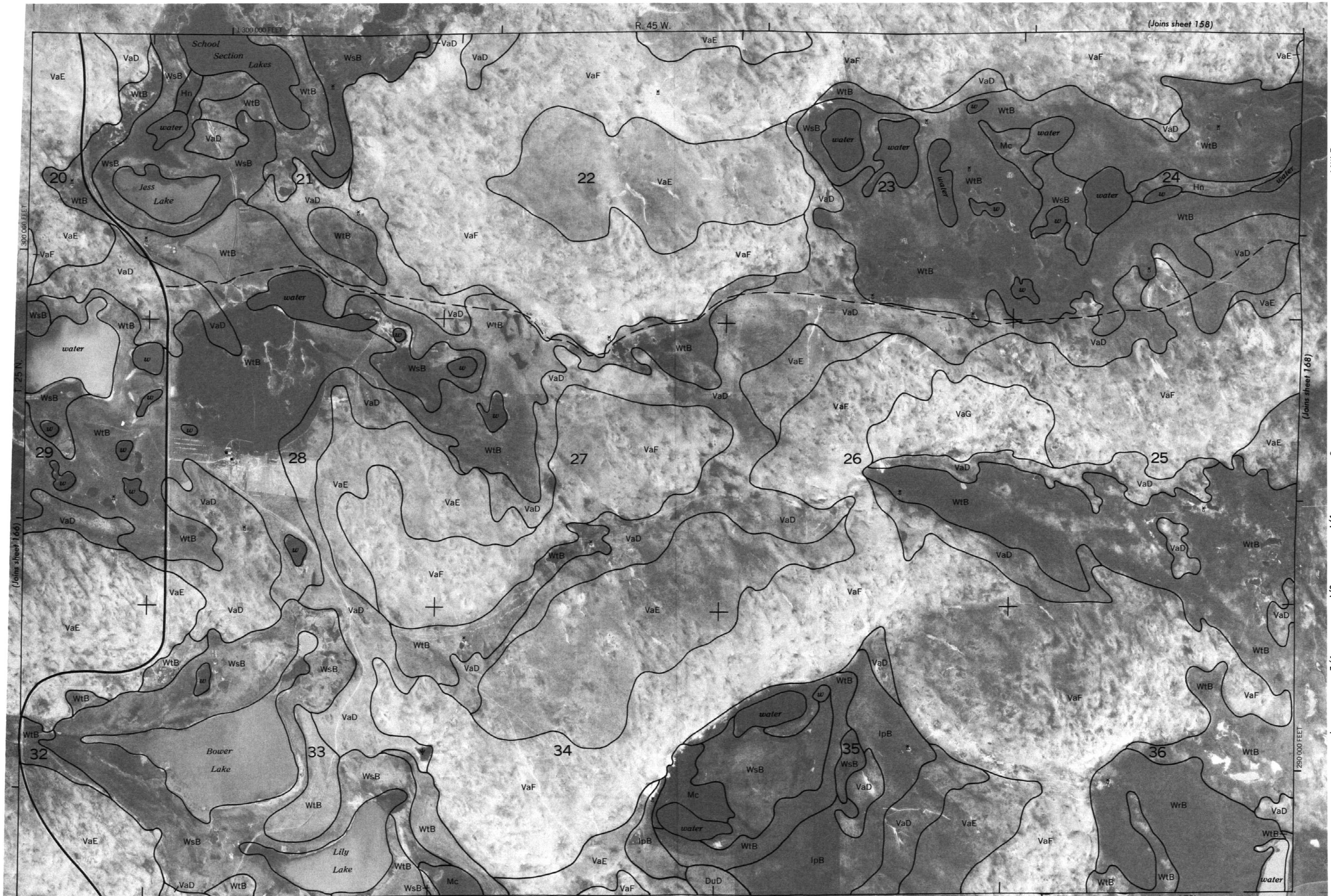
Scale 1:20000

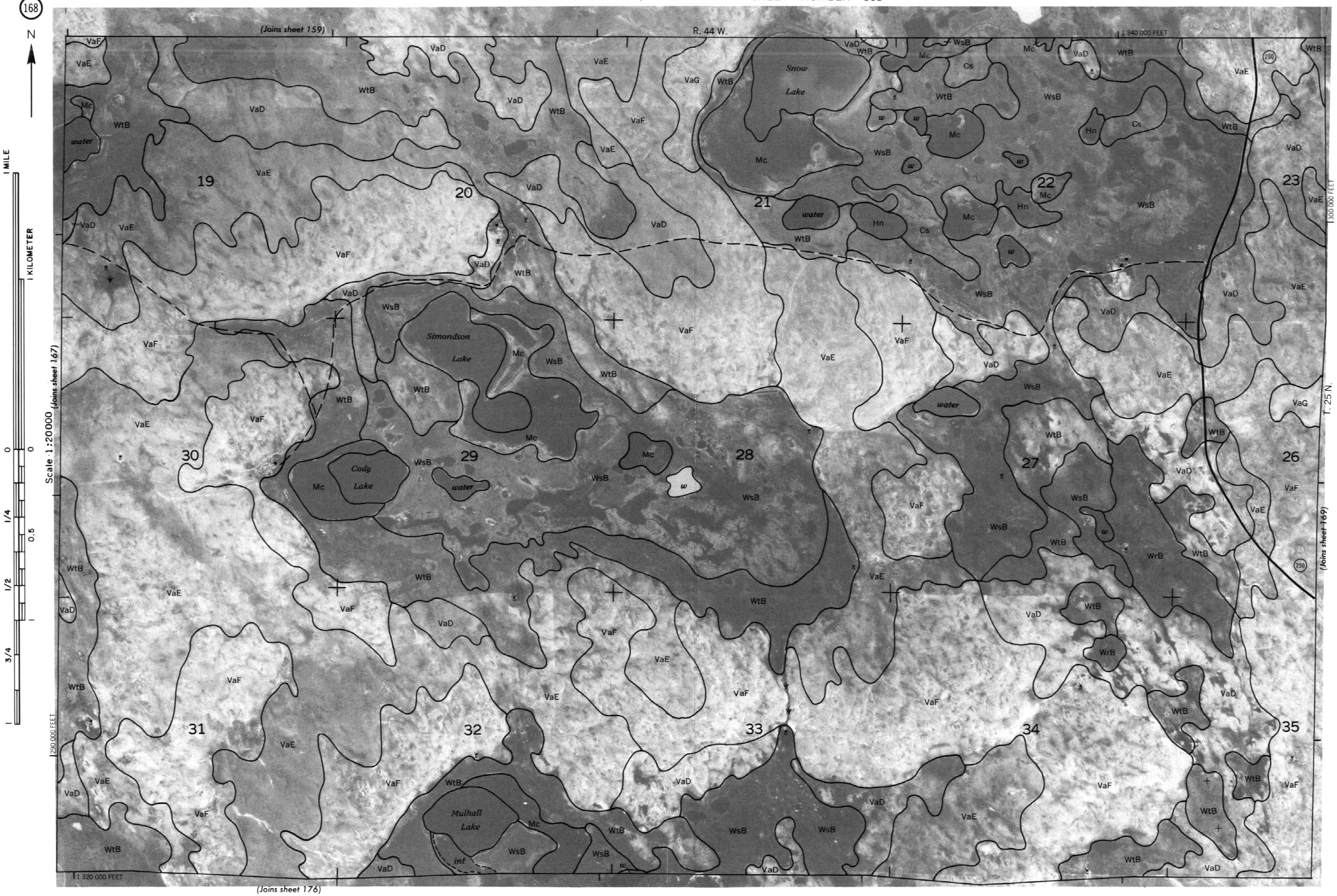
SHERIDAN COUNTY, NEBRASKA NO. 166

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 167



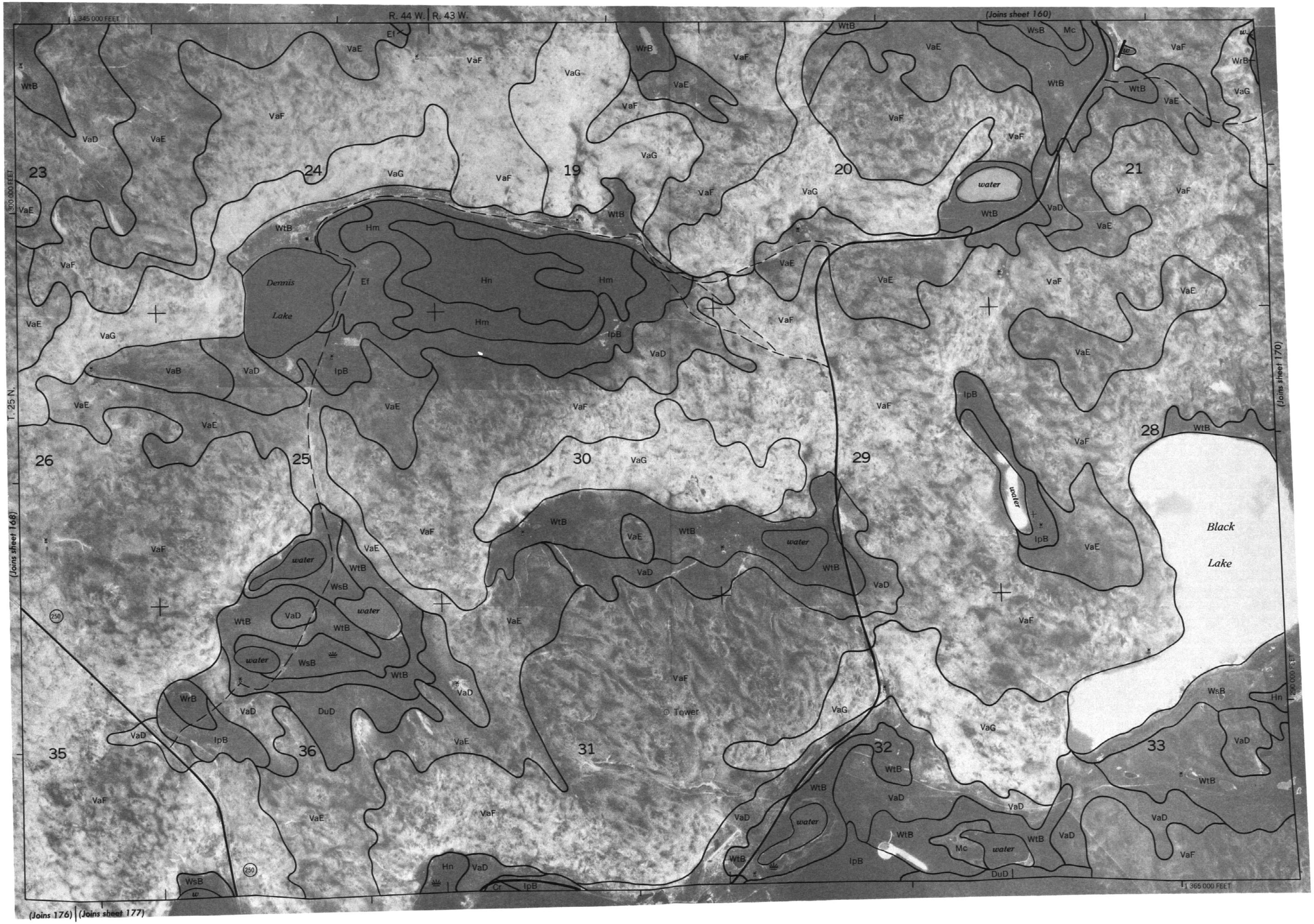


SHERIDAN COUNTY, NEBRASKA NO. 168

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 169



N

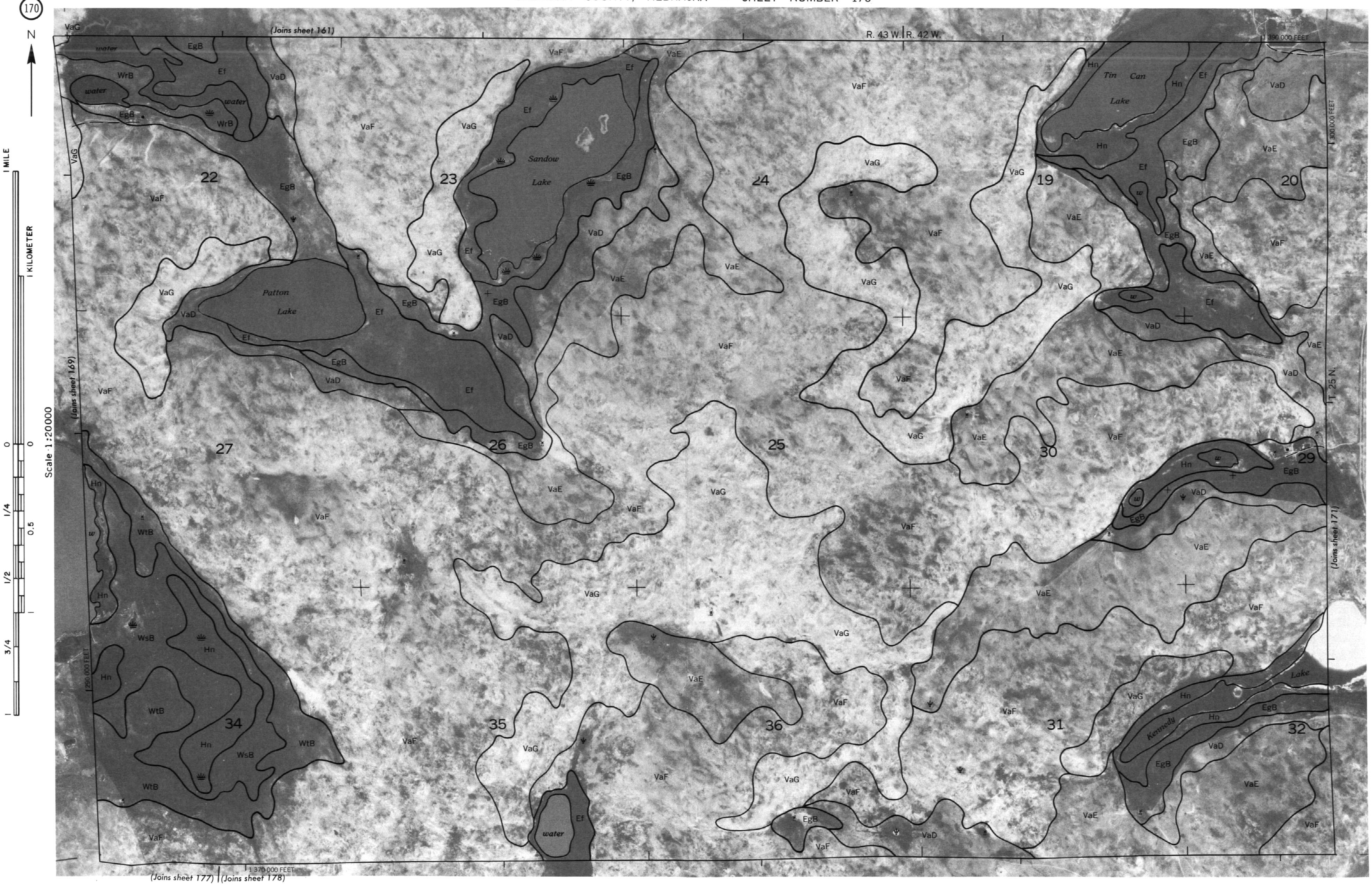
1 MILE

1 KILOMETER

0
1/4
1/2
3/4
1

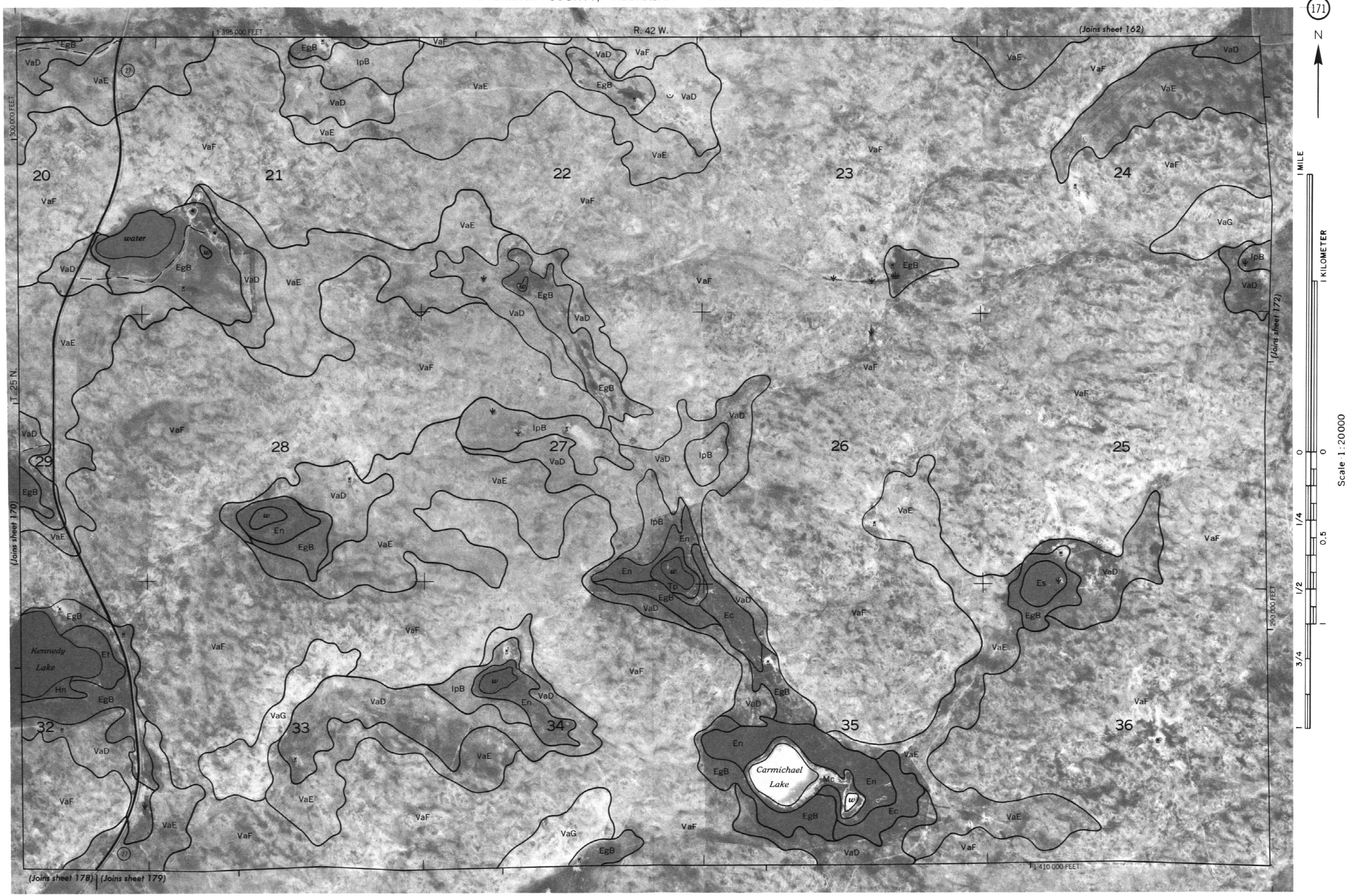
0
0.5
1

Scale 1:20000



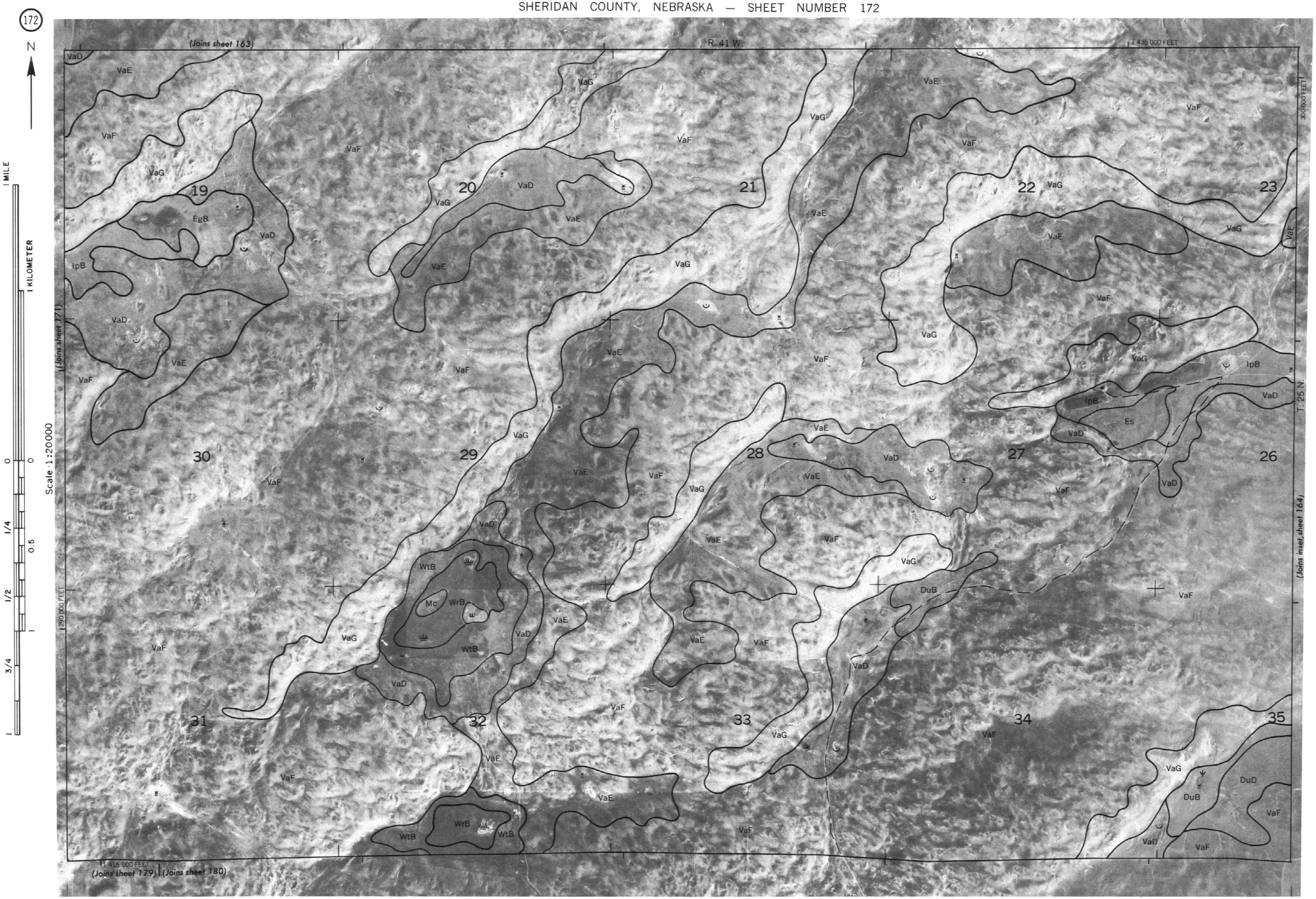
SHERIDAN COUNTY, NEBRASKA NO. 170

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 171

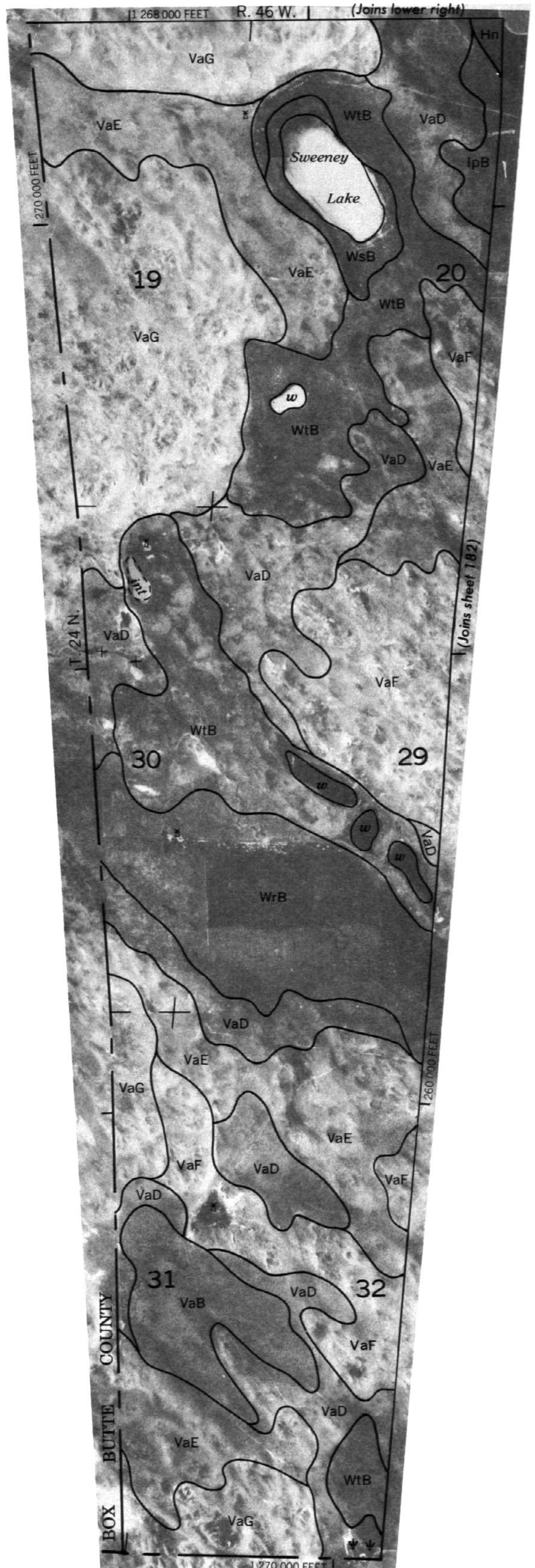


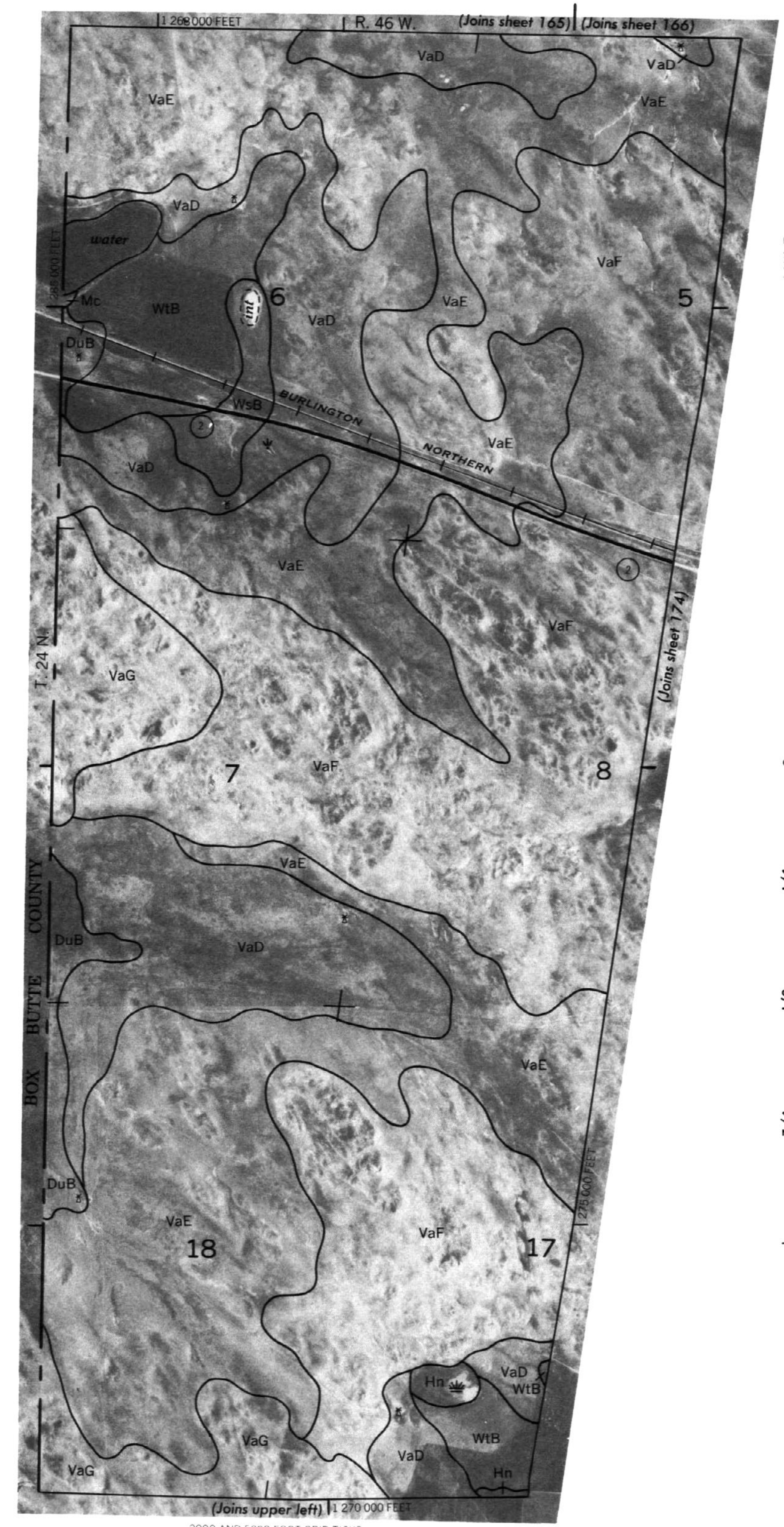
SHERIDAN COUNTY, NEBRASKA NO. 172

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

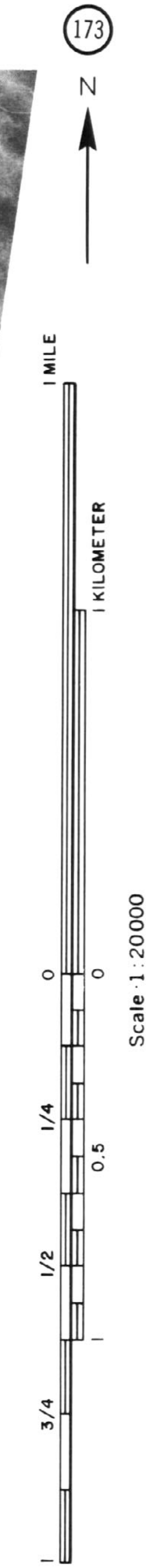
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

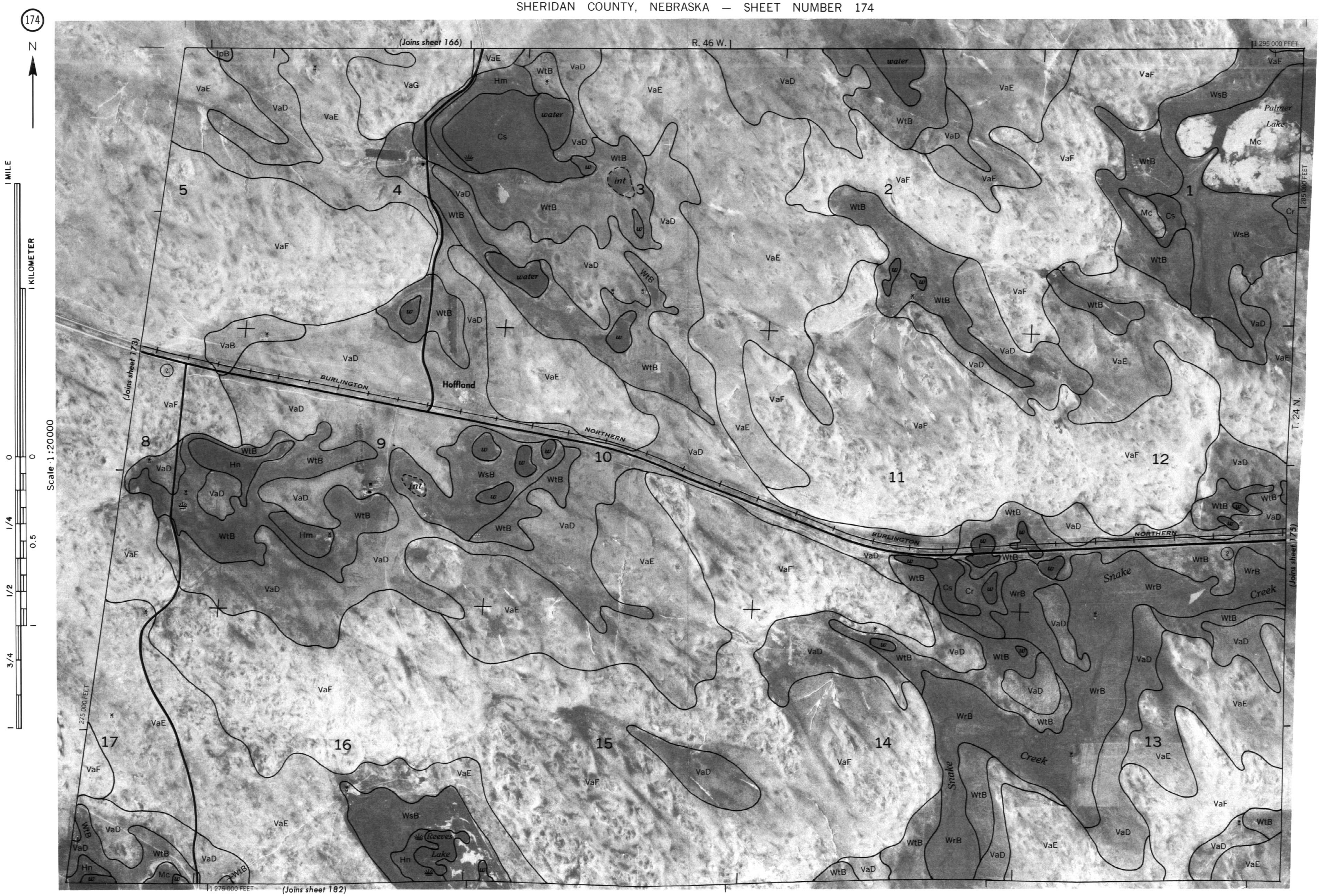
SHERIDAN COUNTY, NEBRASKA NO. 173





2000 AND 5000-FOOT GRID TICKS

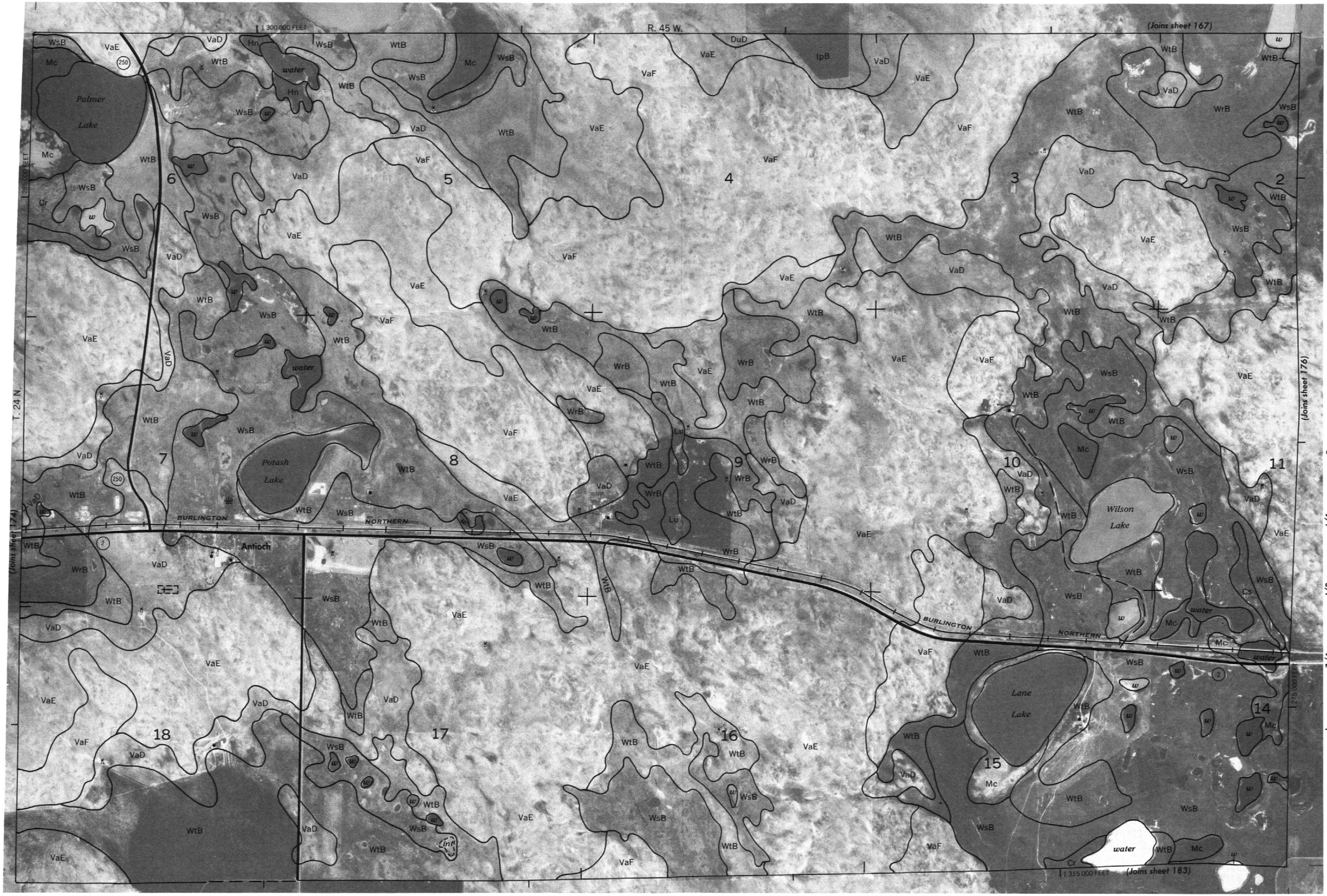




SHERIDAN COUNTY, NEBRASKA NO. 174

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

175



N

1 MILE

1 KILOMETER

0 1/4 1/2 3/4

0 0.5

Scale 1:20000

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 175

176

N

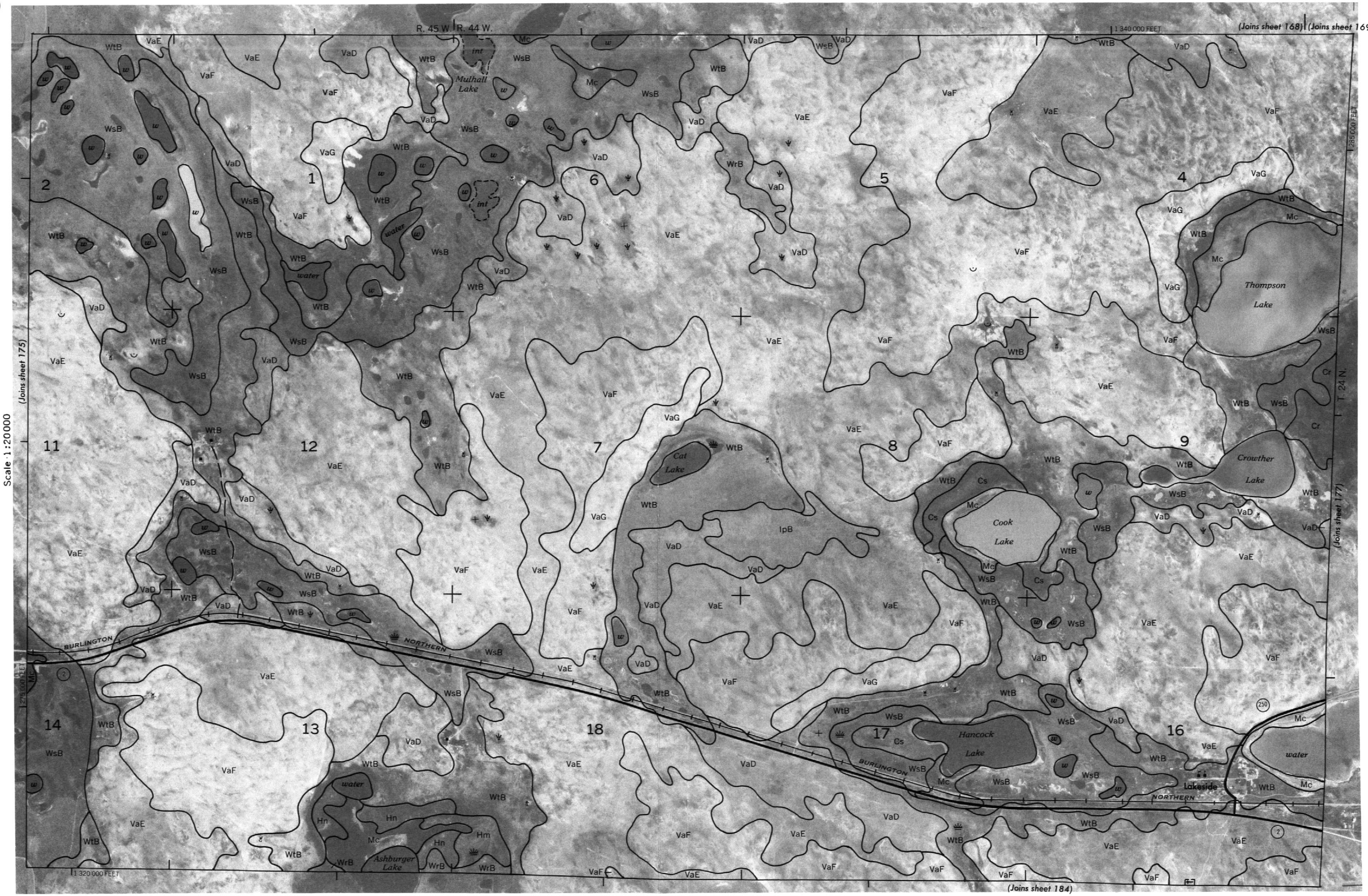
1 MILE

1 KILOMETER

Scale 1:20000

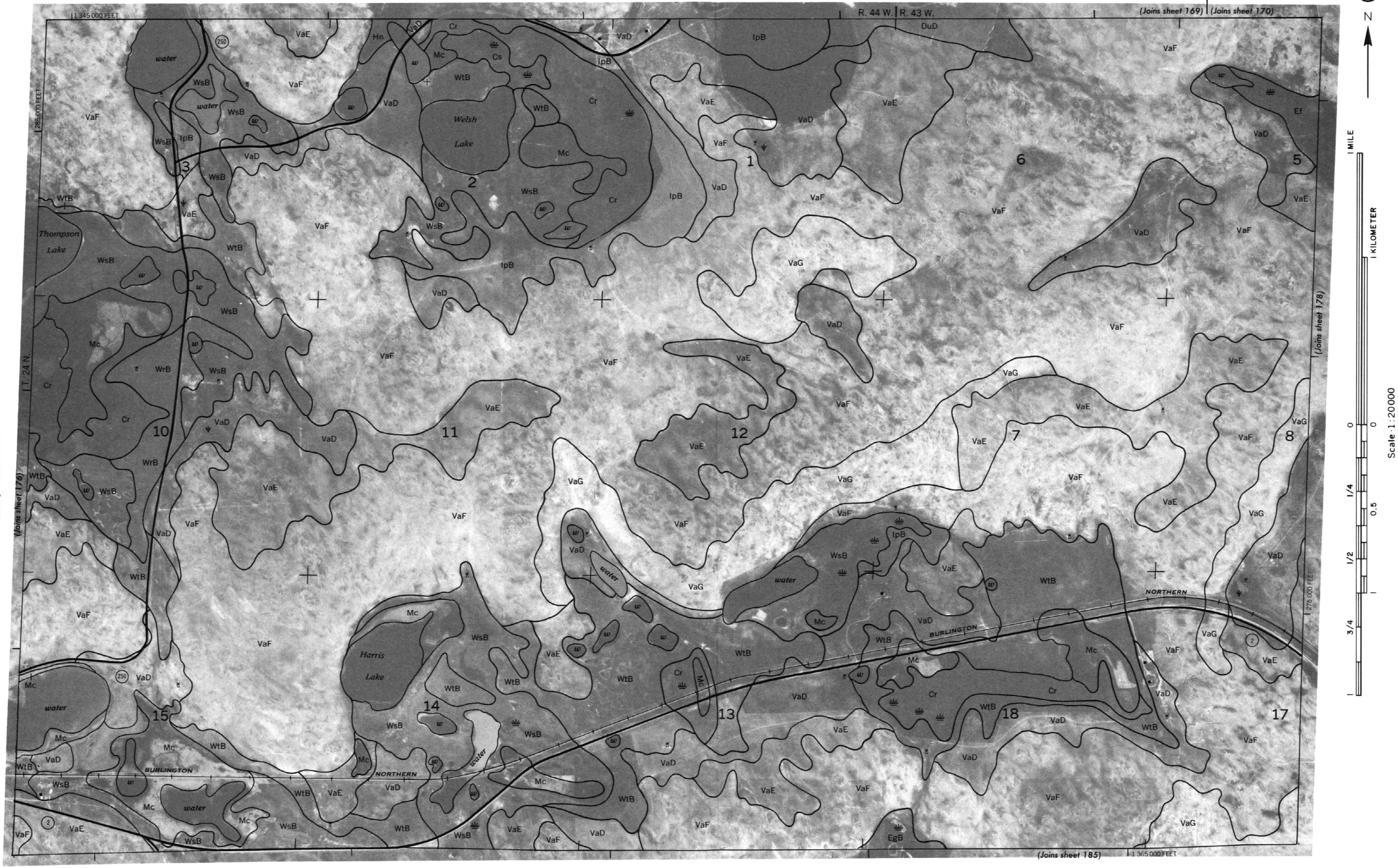
0 1/4 1/2 3/4 1

0 0.5 1

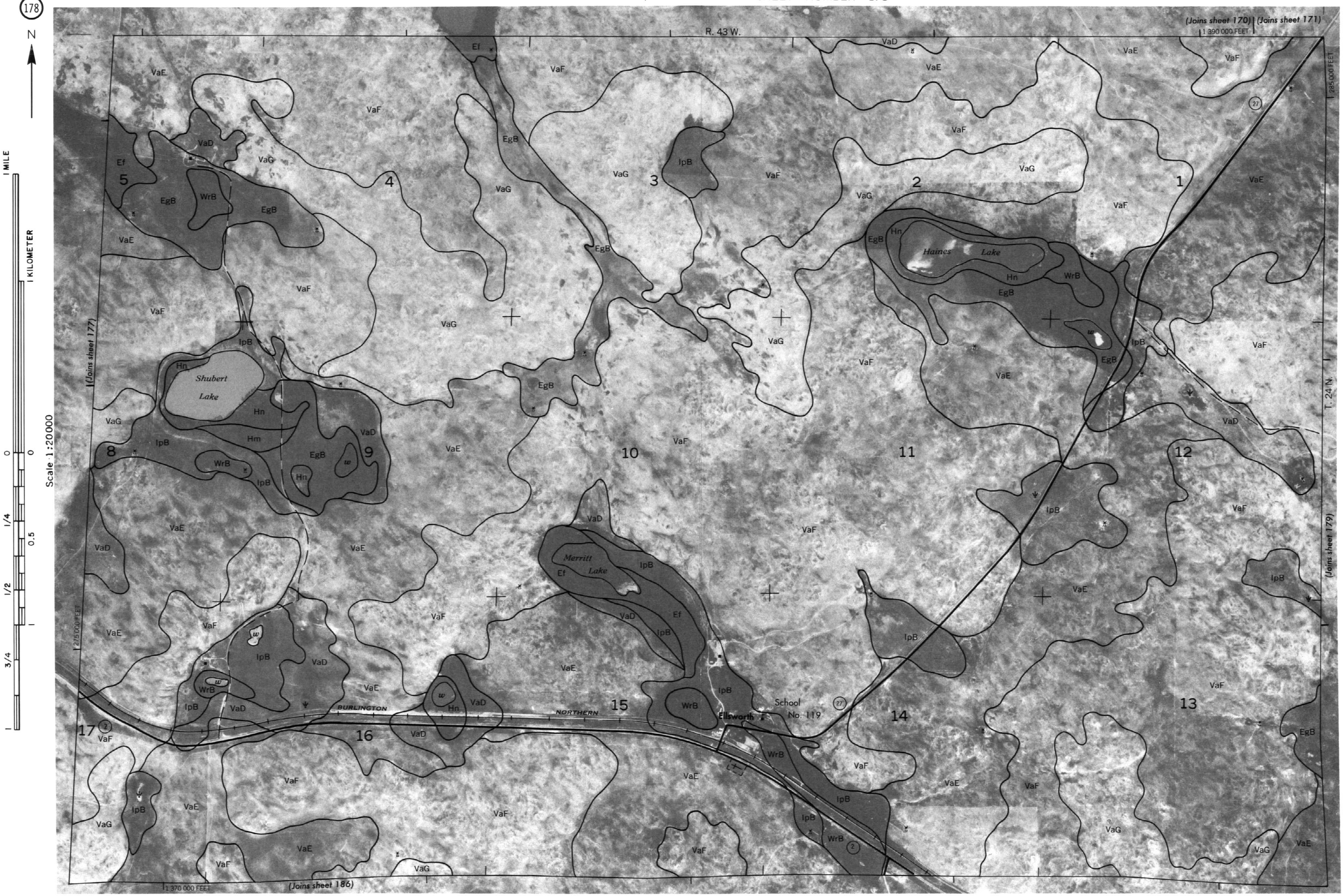


SHERIDAN COUNTY, NEBRASKA NO. 176

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

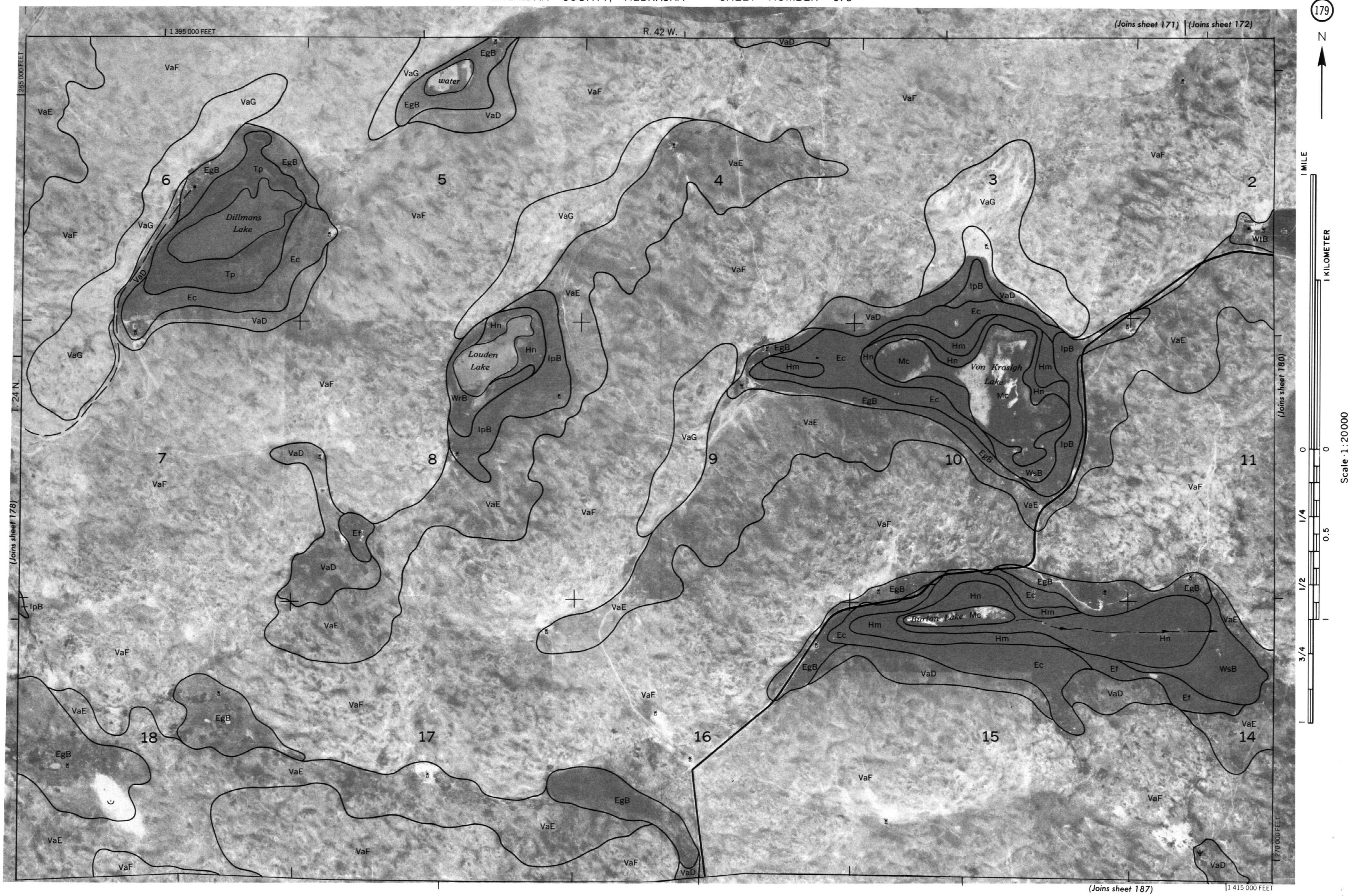


This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



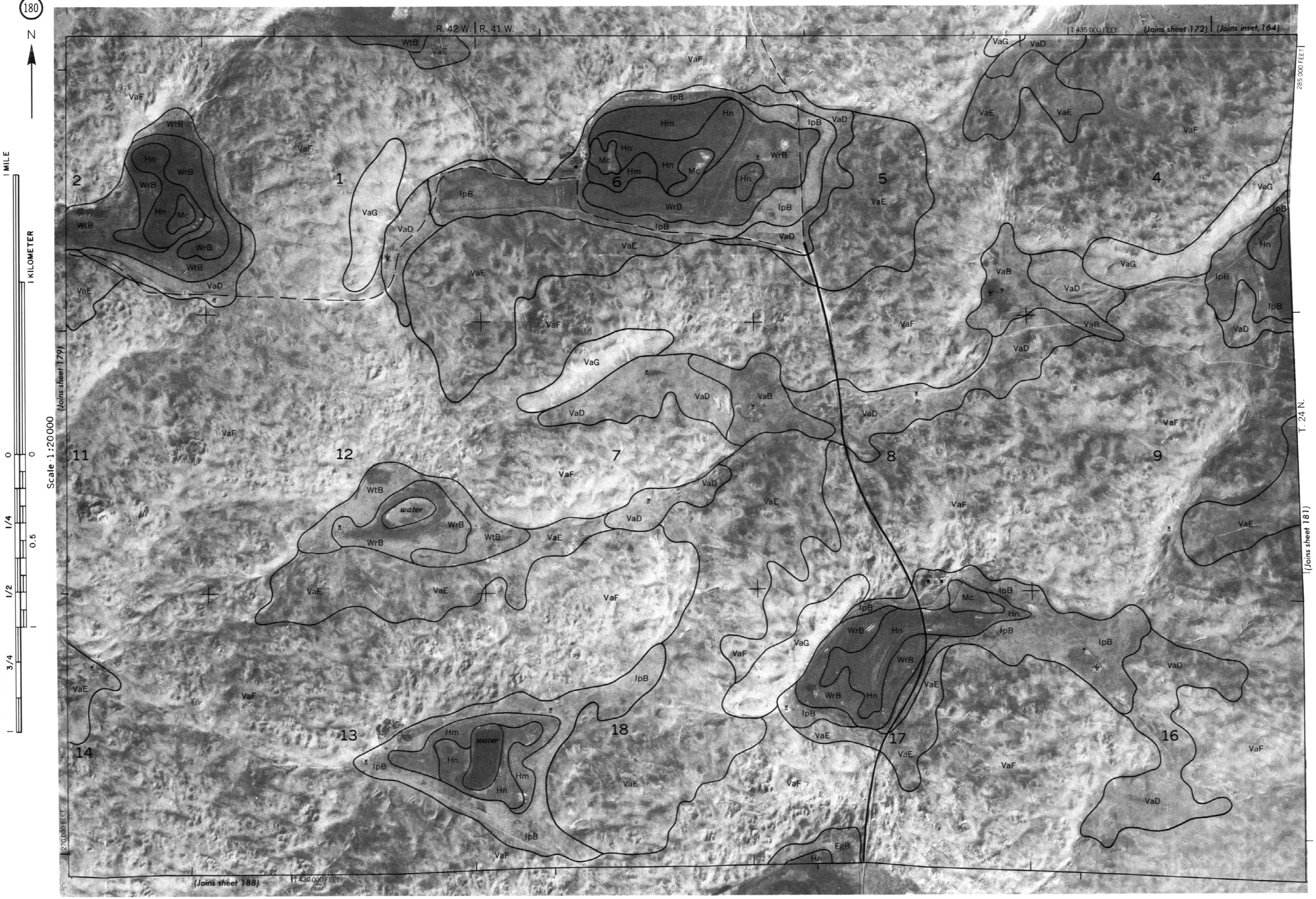
SHERIDAN COUNTY, NEBRASKA NO. 178

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



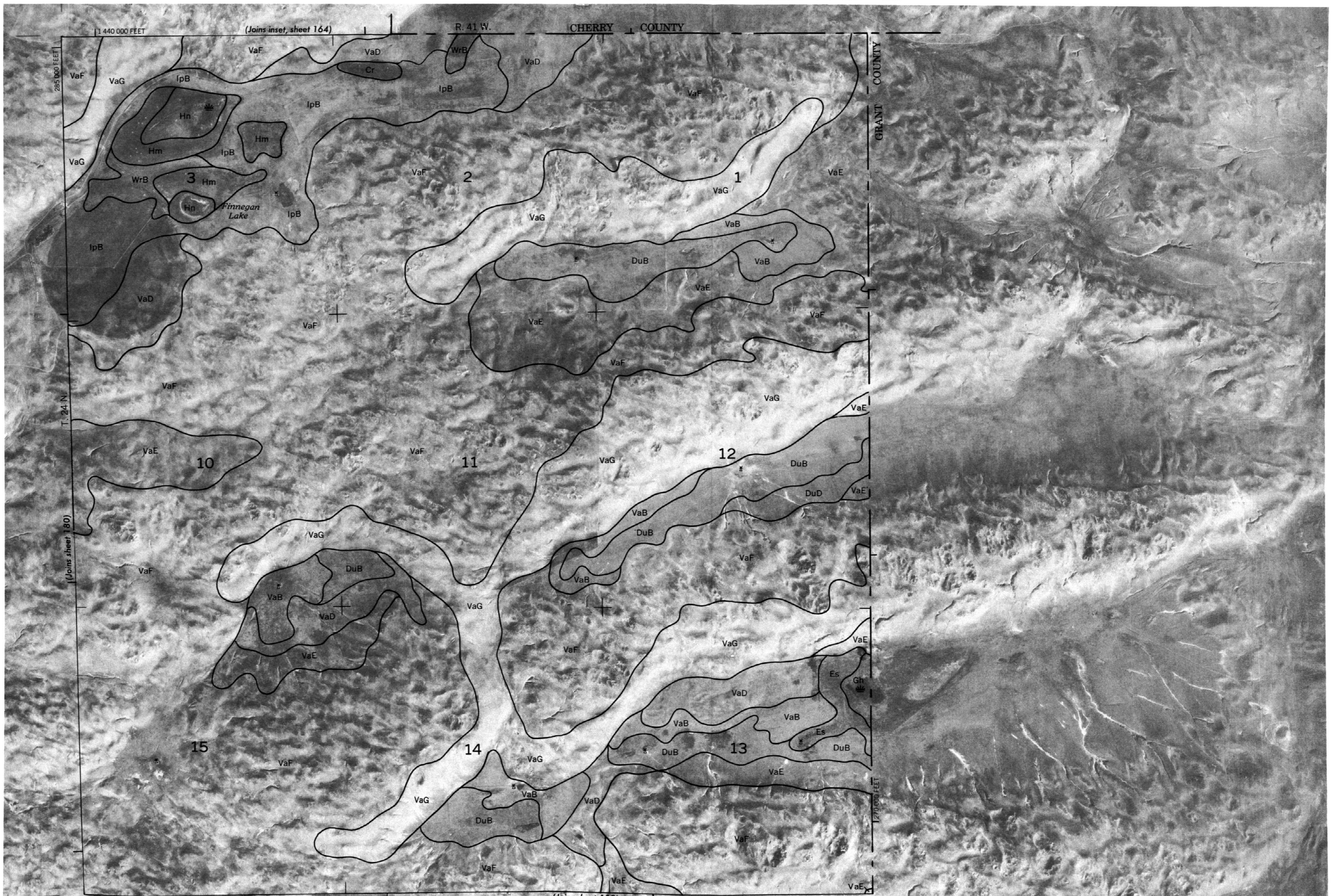
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

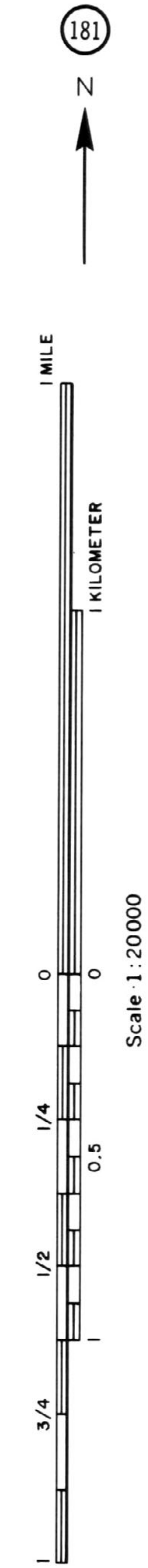
SHERIDAN COUNTY, NEBRASKA NO. 179



SHERIDAN COUNTY, NEBRASKA NO. 180

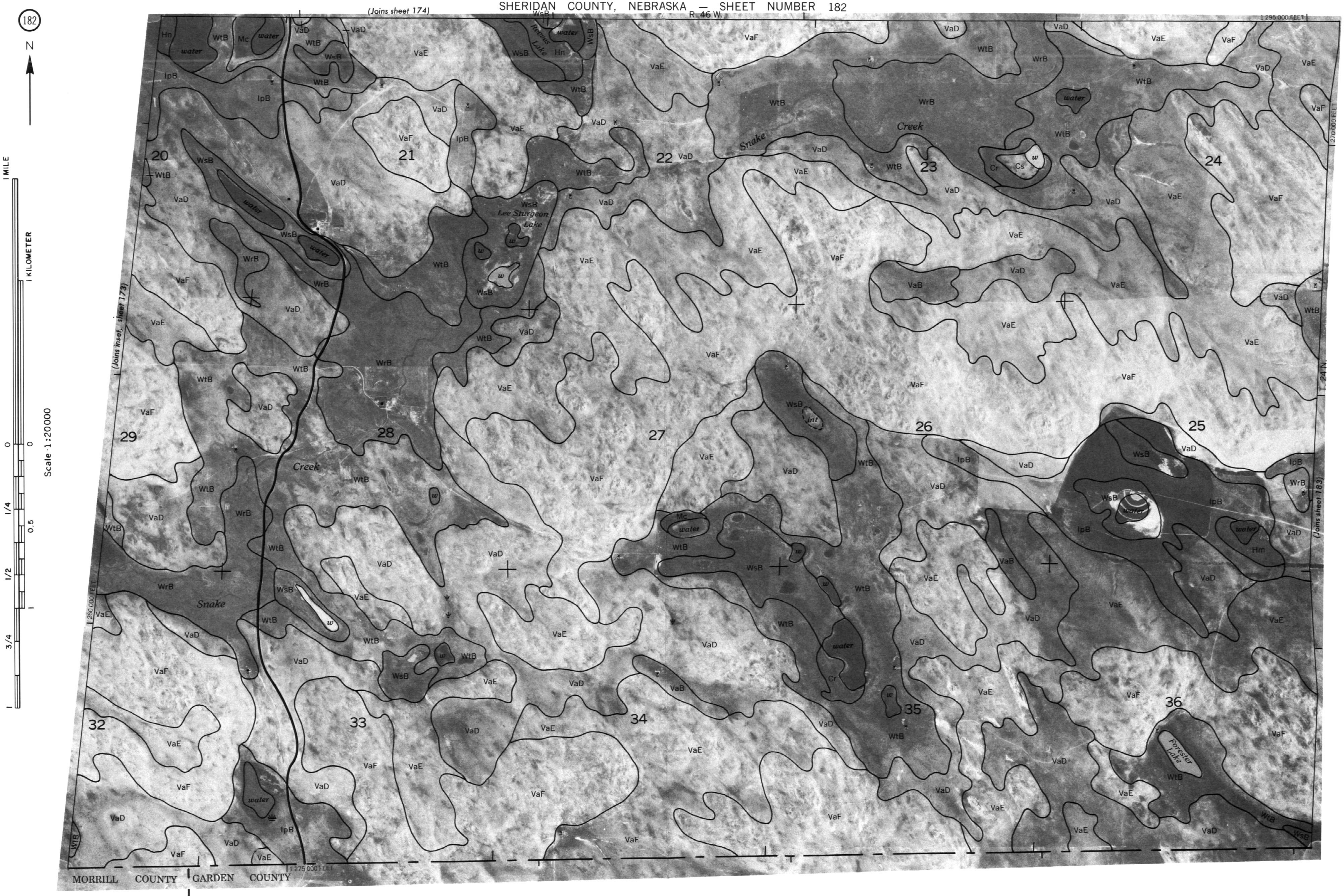
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





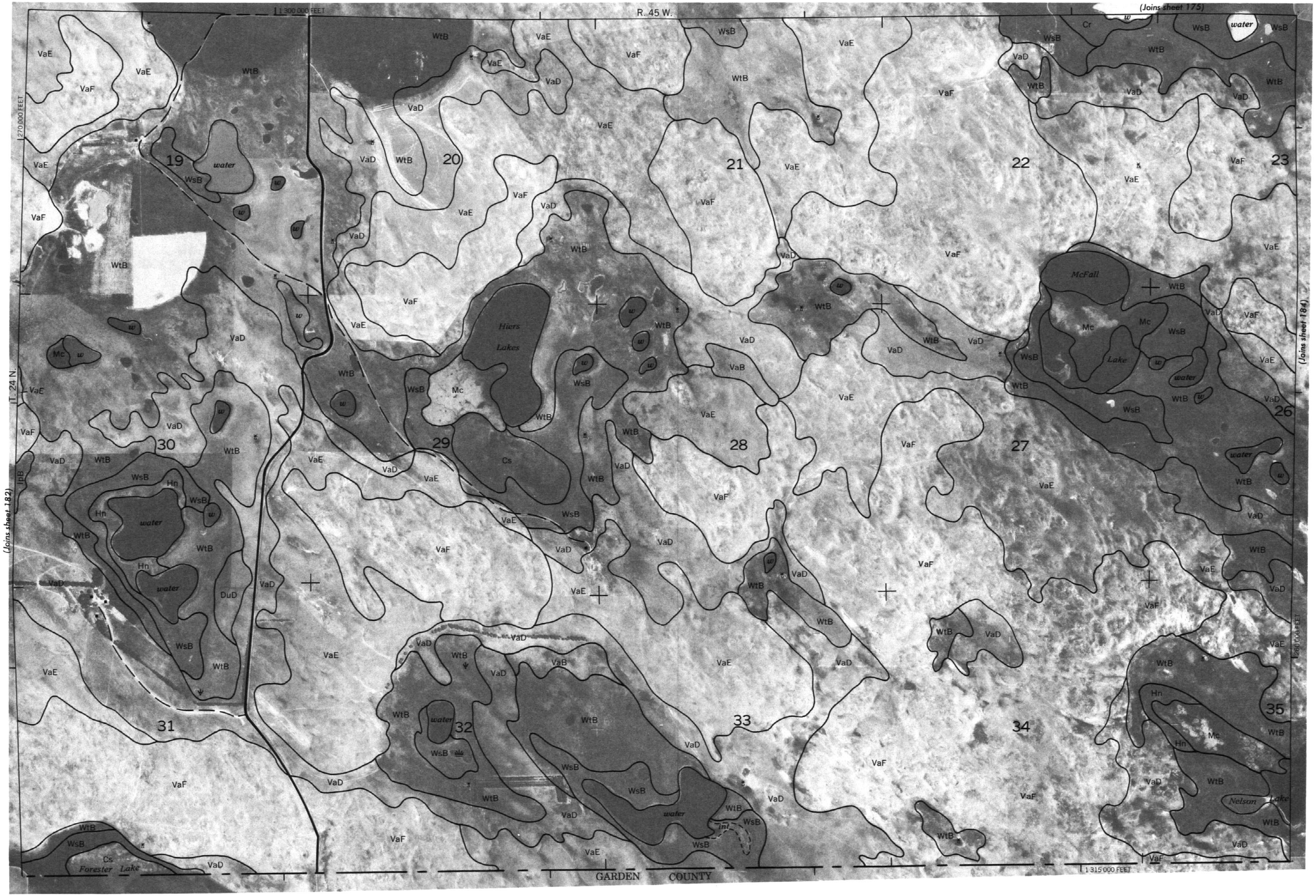
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 181



SHERIDAN COUNTY, NEBRASKA NO. 182

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 183

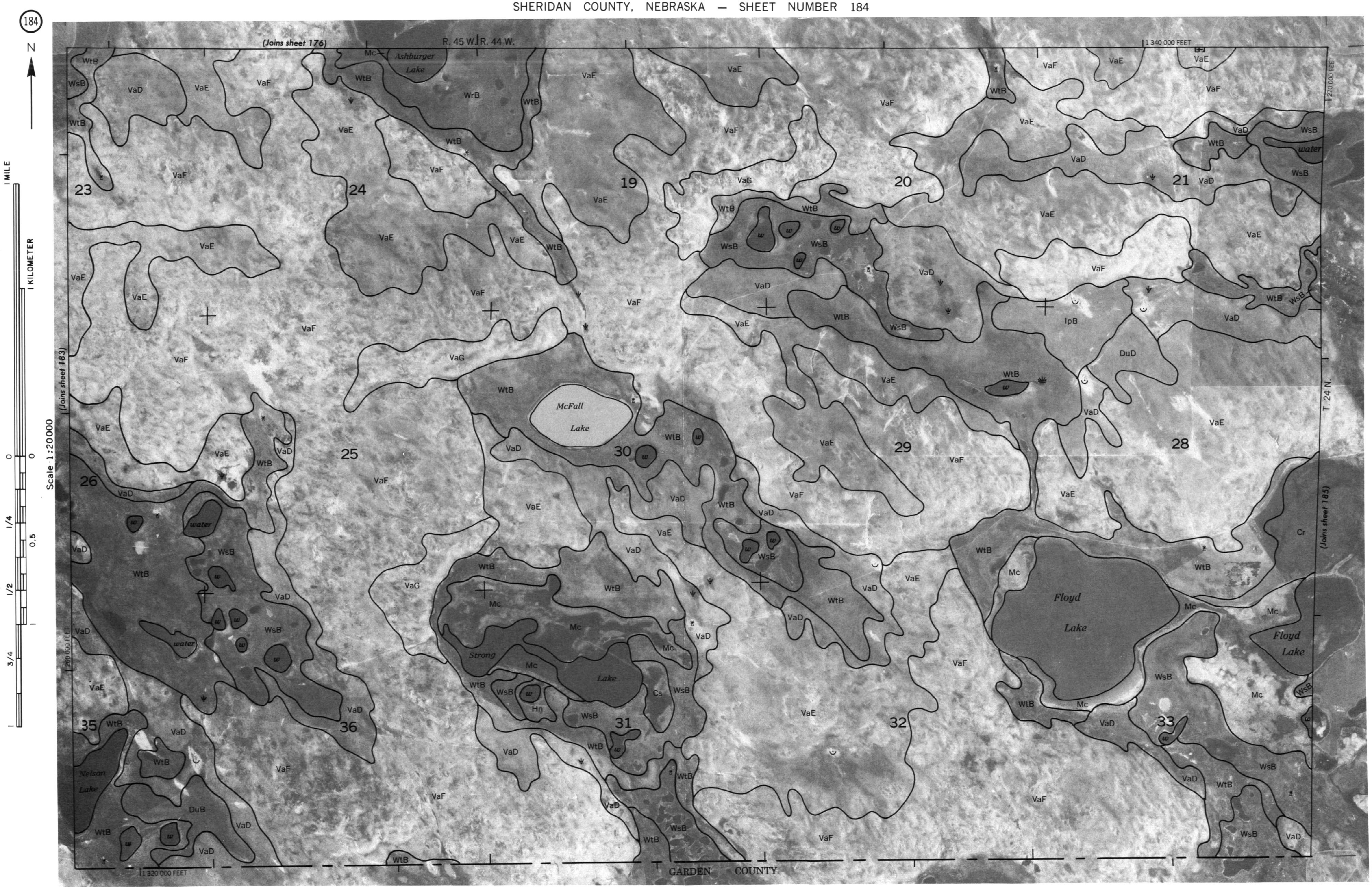
183

N

1 MILE

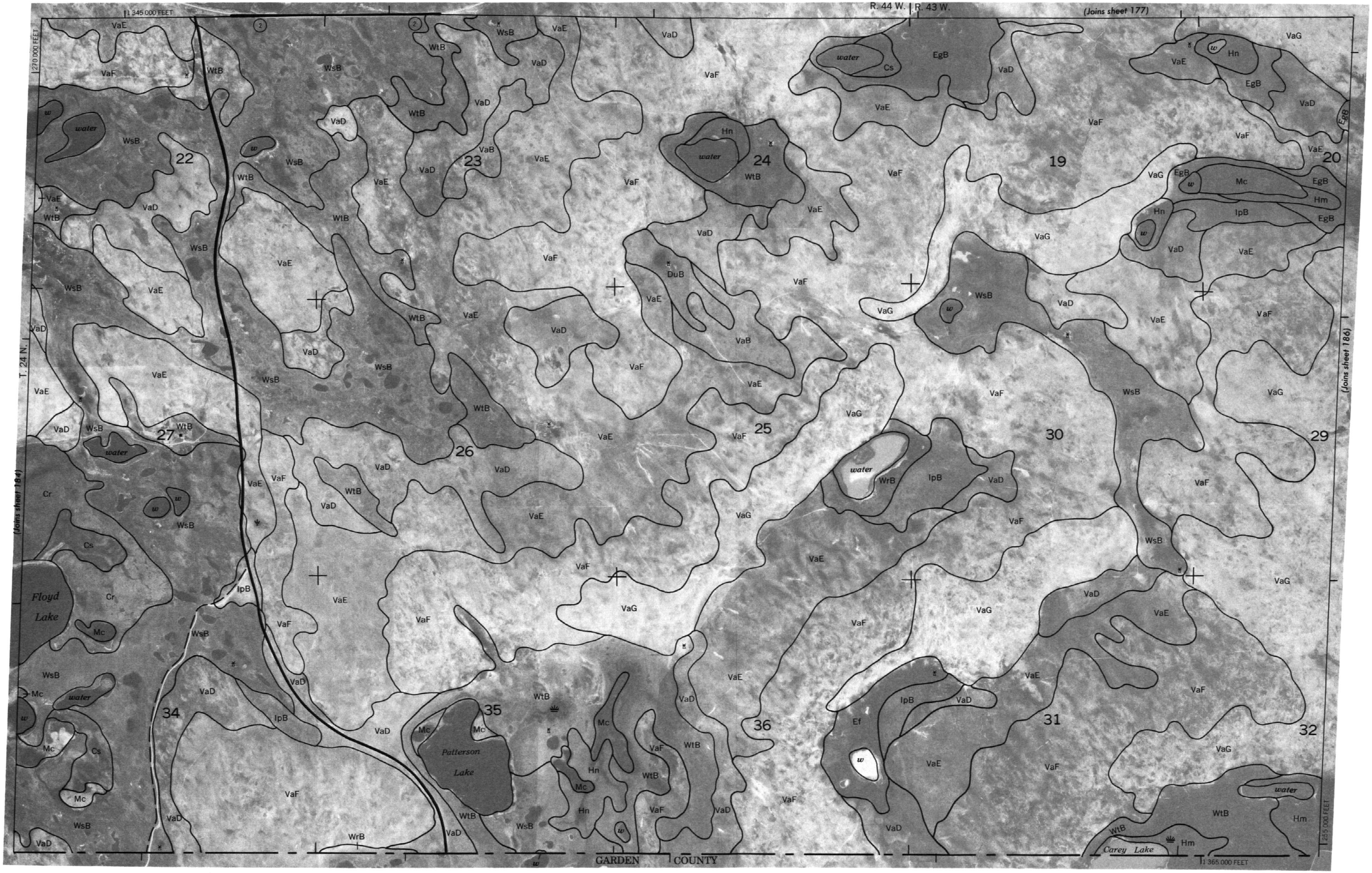
1 KILOMETER

Scale 1:20000



SHERIDAN COUNTY, NEBRASKA NO. 184

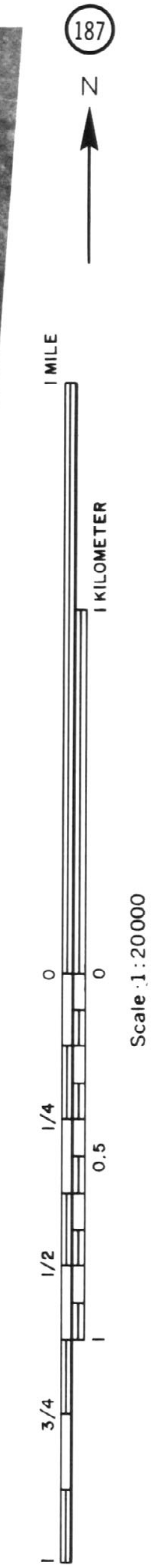
This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

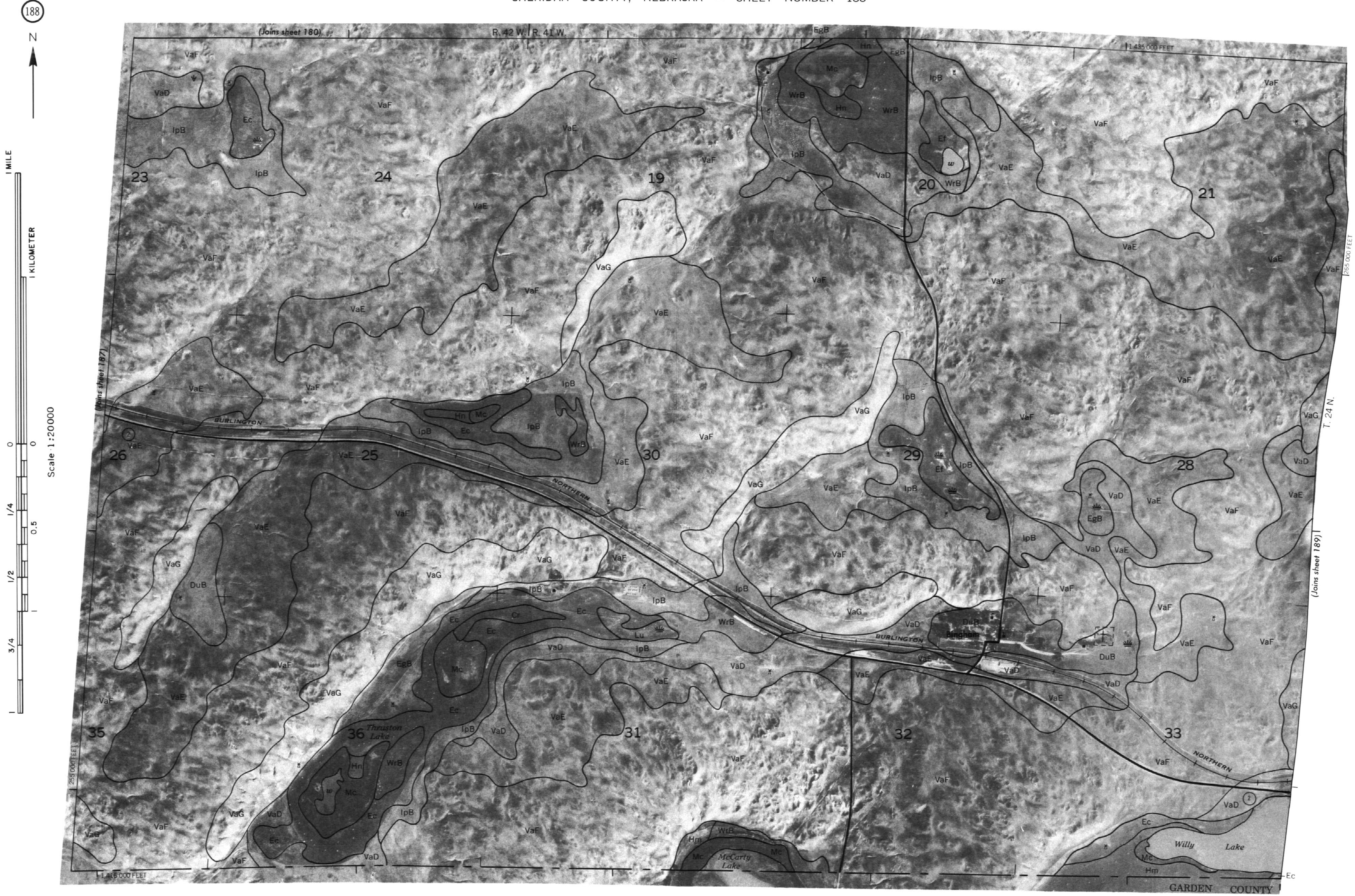
SHERIDAN COUNTY, NEBRASKA NO. 186

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 187



SHERIDAN COUNTY, NEBRASKA NO. 188

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

189

N

1 MILE

1 KILOMETER

Scale 1:20000

This map is compiled on 1977 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SHERIDAN COUNTY, NEBRASKA NO. 189